

# The Impact of Seasonal Changes on Suicidal Ideations in Psychiatric Patients in Georgia: A Pilot Study

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## ABSTRACT

**Background:** Suicidal ideation is a critical concern, particularly among individuals with psychiatric disorders. Understanding the multifaceted factors contributing to suicide is paramount for prediction and prevention. Limited research has explored the association between atmospheric parameters and the mental state of individuals in Georgia.

**Objectives:** This cross-sectional study, conducted in Tbilisi, Georgia, aimed to investigate the relationship between weather variables and suicidal ideation among 52 psychiatric patients. Specifically, we sought to determine if there was a seasonal pattern in the prevalence of suicidal ideation and whether meteorological factors were associated with this phenomenon.

**Methods:** The study collected data using the Columbia Suicide Severity Rating Scale, categorizing the year into four seasons. Meteorological data spanning from October 2021 to September 2022 was obtained. Statistical analyses included Poisson's regression, chi-square, and Fisher exact tests.

**Results:** We observed an increased prevalence of suicidal ideation during the spring and summer seasons (Chi-square = 12.06; df-2; p=0.0072). Our analysis indicates a significant association between humidity and suicidal ideation, supported by a significant regression equation ((F 1.10 = 6.652, p = 0.0275), R<sup>2</sup>= 0.3995). Multiple regression analysis revealed that humidity and the lowest average temperature were significant predictors of participants' suicidal ideation (Pseudo R<sup>2</sup>-0.3496 DF-9). Notably, humidity emerged as a significant predictor of suicidal thoughts (b =-0.1515, p=0.0405).

**Conclusions:** Our findings demonstrate a significant link between weather variables and suicidality in patients with psychiatric conditions, with spring and summer exhibiting heightened risk. This research advances our understanding of suicidality, offering potential insights for enhanced management and preventative care for these vulnerable patients.

**Keywords:** Humidity; psychiatric patients; seasonal patterns; suicidal ideation; weather variable.

## INTRODUCTION

The World Health Organization states that suicide is one of the leading preventable causes of death. Each year, more than 700,000 people die by suicide in the world, which is approximately one death every 40 seconds. Additionally, over 12 million Americans reported severe suicidal ideation, while over 1 million attempted suicides in 2020 alone, according to the Centers for Disease Control and Prevention. Although the causes of suicide are multifactorial and complex, the discovery of seasonal affective disorder in 1984 laid the foundation to establish and further explore a relationship between mental health and seasonal changes.<sup>1</sup> The role of seasonal fluctuations in suicidal ideation in psychiatric patients has not been explored as extensively as it has in the general population.

Weather conditions have shown both positive and negative correlations with mental health factors. Spring, for instance, has been associated with better mood and cognition, but also a peak in suicide attempts by poisoning.<sup>2,3</sup> Additional studies have shown that weather influences the frequency of psychiatric consultations in emergency rooms.<sup>4</sup>

Individuals with bipolar disorder have demonstrated heightened susceptibility to suicidal ideation in response to weather changes.<sup>5</sup>

Climate change's impact on mental health, especially in vulnerable psychiatric subgroups, is a growing concern. Rising temperatures and extreme weather fluctuations can lead to physiological changes, such as fat composition alterations, which can harm mental health.<sup>6</sup> Climate-related factors can contribute to mental health problems, including increased suicide mortality.<sup>7</sup>

This has led to initiatives like the Lancet Commission on Global Mental Health and Sustainable Development, aiming to improve mental health services in poor and middle-income nations.<sup>8</sup> Despite these efforts, the suicide burden remains significant.

Due to the etiological complexity of suicide, every influencing factor requires vigorous investigation to establish further and stratify potential risk factors.<sup>9</sup> This study's primary goal is to assess the impact of seasonal fluctuations on suicidality in psychiatric patients, identifying



the seasons and meteorological parameters most linked to suicide. The study also intends to investigate how suicidality differs in adult psychiatric patients over and under the age of 40. The identification of these risk factors can influence the development of targeted interventions and strategies to prevent suicide.

**METHODS**

In this cross-sectional study, we interviewed 52 individuals using the Columbia Suicide Severity Rating Scale, an interview-based questionnaire designed to identify a history of suicidal ideation. Our study population consisted of Georgian psychiatric patients from the Tbilisi Mental Health Center; all had been diagnosed at least one year before the study. Ethical approval for the research methods was obtained from a clinical ethics board, and written informed consent was obtained from each patient's legal guardian, caregiver, or family member.

After completing the questionnaire, participants were asked if they had experienced the symptoms described on the questionnaire within the last year (October 2021–September 2022) and the month during which the symptoms occurred. The answers were confirmed using clinical records.

The history of suicidal ideation in the past year, age, gender, and psychiatric diagnosis were noted. The National Environmental Agency of Georgia was used to collect meteorological data for this study. Weather data such as maximum and minimum average temperatures in Celsius, average relative humidity in percentage, average daylight hours, and U.V. radiation levels were recorded.

The participants were stratified by gender and age group (21–40 and 41–80) to study the impact of seasonality and different climatic factors on psychiatric patients. The year was divided into four seasons: winter (December-February), spring (March-May), summer (June-August), and autumn (September-November).

All participants in this study were above 20 and had been receiving consistent pharmaceutical care for at least six months. Fluency in Georgian was a requirement for inclusion, and individuals with documented cases of substance use disorders or alcohol use disorders in the previous year were excluded.

The data was analyzed using GraphPad Prism 9.0. Numbers and percentages were used to present qualitative data. The study utilized simple linear regression to establish a link between two variables. The lowest monthly average temperature and humidity in Tbilisi served as independent variables, while the number of individuals who had suicidal thoughts during those months served as a dependent variable. To comprehend the combined effects of these weather variables on suicidal ideations, we also used multiple linear regression. For qualitative data, the chi-square and Fisher exact tests were employed; the latter was

used instead of the chi-square test when the expected count in any cell was less than 5. The confidence interval was established at 95%, with a margin of error of 5% considered acceptable.  $P > 0.05$  was considered non-significant,  $P \leq 0.05$  was considered significant, and  $P 0.01$  was considered highly significant.

**RESULTS**

We used data from 52 Georgian participants with different psychiatric diagnoses. The characteristics of the study population are shown in Table 1. The study population had an average age of 45.83 years ( $\pm 13.46$  S.D.). Among the participants, 28.85% fell within the age range of 21 to 40 years, while 71.15% were aged 41 to 80. Gender distribution showed that 90.38% were male, and 9.62% were female. The majority (84.6%) of participants were inpatients at the Tbilisi Mental Health Center.

TABLE 1. Study population demographic

Age groups, n (%)	
>21 and <40	15 (28.85)
>40 and <80	37 (71.15)
Mean age (S.D.)	45.82 (13.46)
Gender groups, n (%)	
Male	47 (90.38)
Female	5 (9.62)

The psychiatric diagnoses included schizophrenia (69.23%), depression (13.46%), generalized anxiety disorder (3.84%), and various other diagnoses, each representing 1.92% of the total population (Tab.2).

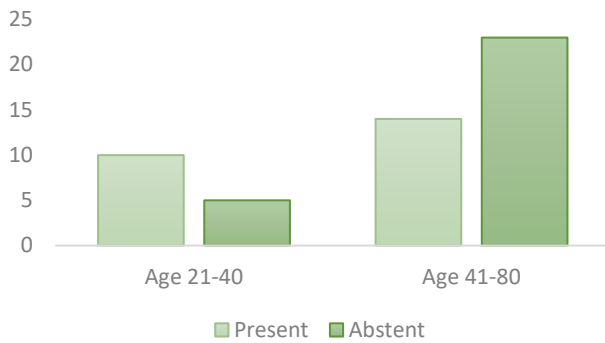
TABLE 2. Patient's Diagnoses

Schizophrenia, n (%)	36 (69.23)
Depression, n (%)	7 (13.46)
Generalized anxiety disorder, n (%)	2 (3.84)
Schizotypal disorder, n (%)	1 (1.92)
Delusional disorder, n (%)	1 (1.92)
Moderate mental retardation, n (%)	1 (1.92)
Anorexia nervosa, n (%)	1 (1.92)
Bulimia	1 (1.92)
Borderline personality disorder	1 (1.92)

Within the study, 44.44% of patients reported experiencing suicidal ideations in the past year. Suicidal thoughts were reported by 66.67% of individuals aged 21 to 40 and 37.84% of those aged 41 to 80. Fisher's exact test

revealed no statistically significant association between the frequency of suicidal ideations in these age groups ( $p = 0.0729$ ) (Fig.1).

FIGURE 1. Frequency of suicidal Ideation in age groups 21-40 and 41-80



Suicidal ideation frequency was recorded for each month of the respective seasons (Tab.3).

TABLE 3. Suicidal ideations in different seasons

Seasons	Number of suicidal ideations
Winter	2
Spring	10
Summer	10
Autumn	2

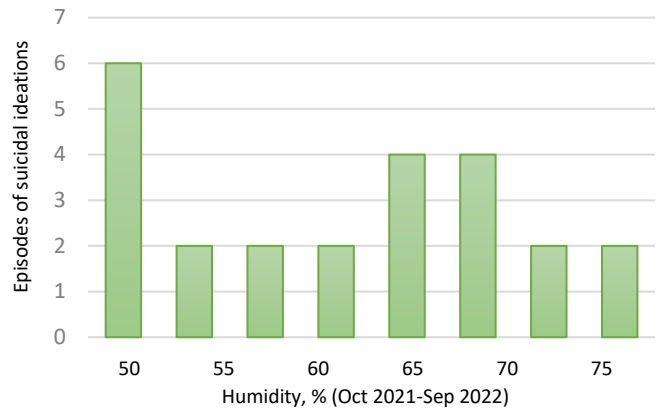
In August, we had the highest number of suicidal ideations (25%), with spring and summer showing statistically significant higher rates of suicidal thoughts (Chi-square = 12.06; df-2;  $p=0.0072$ ).

Weather variables such as relative humidity, lowest average temperature, highest average temperature, and U.V. radiation was taken into account to determine the influence of variations in meteorological factors on suicidal ideations from October 2021 to September 2022. A simple linear regression analysis to understand how humidity predicts suicidal ideations showed a significant regression equation [(F 1, 10 = 6.652,  $p=0.0275$ )] with an R2 of 0.3995, where humidity showed an inverse relationship with suicidal ideations (Fig.2). However, no statistically significant relationship was found between the lowest average temperature and suicidal thoughts (F1,10=2.121,  $p=0.1759$ ; R2=0.175).

Multiple regression analysis was used to test if humidity and the lowest average temperature significantly predicted participants' suicidal ideations with suicidal ideations as the dependent variable and relative humidity in % and the lowest average temperature in °C as independent variables. Weather variables, such as the highest average temperature

and ultraviolet radiation, were excluded from the model due to high multicollinearity in the presence of the two variables (Pseudo R2=0.3496 DF=9). Humidity significantly predicted Suicidal ideations ( $\beta=-0.1515$ ,  $p=0.0405$ ), while the lowest average temperature in °C did not ( $\beta=-0.08255$ ,  $p=0.2555$ ).

FIGURE 2. Relationship between humidity and suicidal ideations



DISCUSSION

Suicidal tendencies often exhibit intriguing patterns, such as weekly fluctuations with higher rates on Mondays and lower rates on weekends, as well as increased risk following major holidays. Additionally, the risk of suicide tends to rise during the spring and summer months while declining in December.<sup>10</sup> Our study aligns with this seasonal pattern, revealing an increase in suicidal ideation during the spring and summer. Similar patterns have been documented in a number of regions around the world. However, suicide still remains a controversial subject that must be addressed.<sup>11,12</sup>

The spring peak has been discovered in the Netherlands as well.<sup>13</sup> Both male and female suicide rates in Iran show substantial seasonality, with peaks in the spring and autumn for violent suicides and the spring and summer for non-violent suicides.<sup>14</sup> Notably, these patterns contrast with the common perception that suicidal thoughts intensify in the winter months.<sup>15</sup> This discrepancy underscores the importance of considering and addressing warmer seasons, such as spring and summer, as potential risk factors for suicide and implementing appropriate preventive measures.

While patterns of seasonality in suicide have been documented across the world, our study focused specifically on Georgia, where such investigations were lacking. This regional specificity highlights the need for more localized studies to capture variations in climatic influences on suicidality, as weather patterns and their impact can vary significantly from one location to another.

Numerous factors may contribute to the observed spring and summer peaks in suicidal ideation. Research suggests that rapid temperature changes, occurring twice a year, may activate brown adipose tissue and exacerbate depressive symptoms.<sup>16</sup> Additionally, sunlight exposure may play a role

by promoting impulsivity and influencing serotonin neurotransmission, potentially triggering suicidal behavior.<sup>17</sup> The lower energy levels typically experienced during winter may act as a protective factor, as it requires energy to act on suicidal thoughts. Furthermore, during summer, patients in psychiatric care may witness friends and family enjoying holidays, which could contribute to increased feelings of despair, akin to the "broken-promise effect" often associated with holiday seasons.<sup>18</sup>

Our study delved into meteorological factors, including humidity and temperature, to explore their influence on suicidal ideation. Notably, relative humidity exhibited an inverse relationship with suicidal ideation, aligning with previous research highlighting its substantial correlation with suicide rates, even exceeding that of heatwaves.<sup>19</sup> Although we did not establish a direct association between temperature and suicidal thoughts, existing studies have indicated such a connection.<sup>20,21</sup>

Furthermore, our findings resonate with several Asian studies that have revealed the detrimental impact of temperature fluctuations on mental health and overall well-being.<sup>22,23</sup> A particularly pertinent study, investigating the interplay between temperature and humidity, postulated that saturated air's reduced ability to extract moisture from the skin's surface might compromise the effectiveness of sweating in mitigating heat-related stress. This, in turn, was linked to an increased likelihood of experiencing high or very high distress as heat and/or humidity levels rose.<sup>24</sup>

These collective findings underscore a robust and adverse relationship between climate change and mental health. Recognizing the significance of climate-related factors in mental health interventions is increasingly imperative.

The gender and age distribution of our study population highlighted disparities in suicidal tendencies. Globally, suicide rates show a male-to-female ratio of 1.9.<sup>25</sup> However, these ratios can be influenced by various socioeconomic factors, especially in developing regions. Given the predominance of male participants in our study, we were unable to comprehensively assess how seasonal fluctuations in suicidality affect both genders differently. Age also emerged as a potential influencer, with older individuals possibly more vulnerable to weather-related effects due to diminished thermoregulatory mechanisms.<sup>26</sup>

While our study provides valuable insights into the relationship between seasonality, climate, and suicidality in psychiatric patients, several limitations warrant consideration. The inpatient nature of our study population may have introduced confounding variables related to facility conditions. Further research should explore the outpatient demographic to identify potential differences in outcomes. Additionally, the diverse range of psychiatric diagnoses in our study calls for future investigations into

how specific diagnoses and illness severity may impact suicide rates.

Many of the studies referenced in this paper focused on seasonality within limited time frames and specific geographic regions. This approach is understandable, given the frequent weather variations and unique climatic conditions experienced in different locations. However, it is crucial to emphasize the need for replication of these findings across diverse geographic regions to gain a comprehensive understanding of how seasonality impacts suicide behavior.

The sample size was kept small due to limited access to Georgia's psychiatric patient population. Nonetheless, our findings contribute substantially to our knowledge of psychiatric disorders.

## CONCLUSIONS

In conclusion, our study contributes to the understanding of seasonal patterns in suicidal tendencies among psychiatric patients, emphasizing the significance of spring and summer peaks in suicidal ideation and a significant association with climatic conditions, specifically its negative relationship with humidity in Tbilisi, Georgia. By identifying the factors contributing to these patterns, we can work towards developing more effective suicide prevention strategies. These findings underscore the importance of considering climate-related factors in mental health care and highlight the need for further research to refine our understanding of these complex relationships.

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