An Umbrella Systematic Review of Seasonality in Mood Disorders and Suicide Risk:

The Impact on Demand for Primary Behavioral Health Care and Acute Psychiatric Services

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ABSTRACT

Objective: To review the current literature focusing on the most recent systematic reviews relating to mood, suicide, and psychiatric service utilization.

Study Selection and Data Extraction: A systematic literature search of PubMed, CINAHL, and PsycINFO databases using the search terms "Systematic review" AND "season*" AND mood OR depression OR bipolar OR psychosis OR suicid* OR psychiatr* initially yielded 209 results. After screening by title and abstract for relevance, 6 records remained, while a further 3 were identified after screening of reference lists. A qualitative synthesis of these results was then performed due to data heterogeneity between studies.

Results: We found evidence of winter peaks for depressive symptoms and suggestions of summer peaks for suicidal activity, emergency department (ED) self-harm presentations, and manic-related hospital admissions. Suicide is 11%–23% more frequent in spring and summer. ED suicide attempts are also 1.2–1.7 times higher in spring and summer compared to winter. Admissions for mania are 7.4%–16% higher in spring and summer, while there are 1.5 times more admissions for bipolar depression in winter months.

Conclusions: There is a summer peak for many aspects of mental health activity, particularly in terms of acute hospital utilization and suicidality. This is contrary to the winter-related peak of depressive symptoms. Further research is needed to affirm these findings.

Prim Care Companion CNS Disord 2023;25(3):22r03395

To cite: Della DF, Allison S, Bidargaddi N, et al. An umbrella systematic review of seasonality in mood disorders and suicide risk: the impact on demand for primary behavioral health care and acute psychiatric services. *Prim Care Companion CNS Disord.* 2023;25(3):22r03395.

To share: https://doi.org/10.4088/PCC.22r03395

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Managing demand for psychiatric and behavioral health care is a key issue facing contemporary primary care and specialist services. Observational data indicate significant seasonal variation in service demand; however, there remains a lack of consensus regarding how seasonality should be accounted for and added to models predicting and managing primary care, hospital, and other psychiatric service resources. This is despite an ever-increasing demand on such services throughout the Western world, which early evidence suggests has been further exacerbated by the COVID-19 pandemic.[1,2] High demand for psychiatric emergency services in particular leads to poor patient and health system outcomes through long emergency department (ED) wait times and the experience of "boarding" in EDs.[3]

The concept of seasonal variation in mood has been of interest for millennia, with the Greek philosopher Posidonius writing "melancholy occurs in autumn, whereas mania in summer."[4] This level of interest has been maintained over the centuries, before Enrico Morselli and Émile Durkheim independently identified the link between the spring and summer seasons and suicide in the 19th century.[5,6] More contemporary research has affirmed that this link has existed since the medieval period (specifically the 13th to 16th century).[7] Debate about the significance of such seasonal variation has continued to the modern day, which was further exacerbated by the characterization of seasonal affective disorder in 1984, the very existence of which has been questioned by previous studies.[8]

This article will therefore aim to synthesize previous research across various psychiatry settings and contexts as they relate to seasonality, which to date has not been reported in the literature. This will involve analyzing recent systematic reviews and other key publications to determine the current state of the research into seasonality and its effects on rates of mood disorders, ED psychiatric presentations, hospitalizations, and suicide rates. In addition to potentially assisting with service planning and the appropriate allocation of resources, this research may further assist with developing possible preventative approaches and the ongoing search for etiologic factors driving seasonal variation in psychiatry by uniting prior research across various clinical settings.

Clinical Points

- Clinicians should inquire about seasonal variations in psychiatric symptoms, including changes in mood, suicidality, and acute service utilization.
- From a clinical perspective, bipolar affective disorder has a particularly strong seasonal pattern, which may require clinicians to provide more preventative strategies in the context of seasonal relapses during the spring and summer months including specific relapse prevention plans, monitoring for early warning signs, and possible medication adjustments.

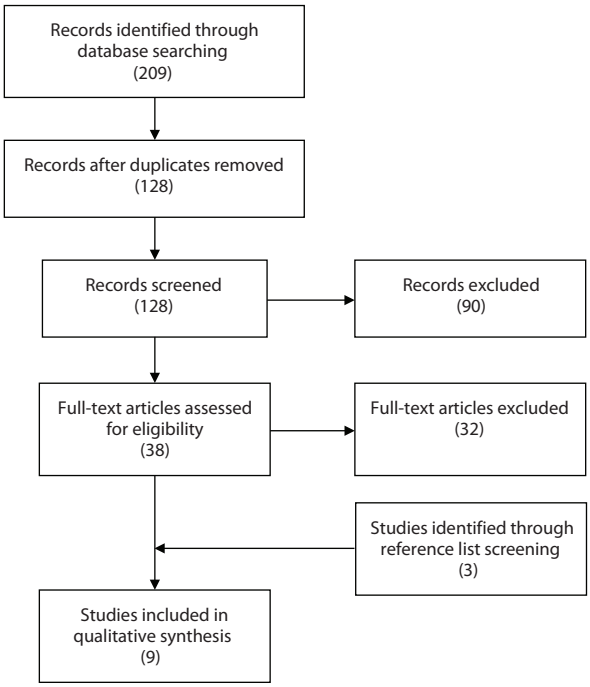
METHODS

We employed a search of the following databases: PubMed, CINAHL, and PsycINFO. Search terms were selected to identify relevant references for systematic reviews relating to seasonal variation in various psychiatric domains. These terms were "Systematic review" AND "season*" AND mood OR depression OR bipolar OR psychosis OR suicid* OR psychiatr*. The final search was conducted on July 31, 2022. After searching the databases, records were downloaded into the EndNote program. Records were de-duplicated before initial screening by title and abstract by a single author.

The key inclusion criteria were review articles that assessed the seasonal impact on health service utilization for psychiatric reasons, or the incidence/prevalence of psychiatric conditions including suicide (including suicide identified by death registry analysis). Exclusion criteria included studies assessing treatment options for seasonal psychiatric disorders, studies only including selected subgroups such as a single method of suicide (due to lacking external validity), articles not in the English language, and articles published prior to the year 2000 (allowing us to focus on the most recent review articles). Following initial screening, the remaining studies were subjected to a full-text review using the same criteria. The references of these articles were also screened for any other potentially relevant articles for inclusion, which were then subject to full-text review.

In total, 6 articles were found through the systematic review process,[9–14] while 3 were found through screening of references.[15–17] This process is outlined in the PRISMA diagram in Figure 1. A summary of all included reviews is provided in Table 1.

Figure 1. PRISMA Flowchart



RESULTS

Mood Disorders

Two major systematic reviews[9,15] have investigated the seasonal distribution of mood disorders. In the most recent of these, Øverland et al[9] examined 41 studies relating to depression and seasonality. Notably, this review[9] excluded from its analysis any primary study that referred to seasonality when interviewing patients, such as through the use of the Seasonal Pattern Assessment Questionnaire, due to the inherent risk of bias. Of the included studies, 10 investigated the prevalence of clinical depression. Of those studies, 5 found a higher prevalence in winter, 3 found no indication of seasonality, and the remaining 2 found peaks in summer/autumn and spring (Table 2). A further 9 studies investigated the prevalence of depressive symptoms. Four of these studies found some modest evidence of winter seasonality. Of the remaining studies, 4 found no seasonality, while 1 found higher depression scores in autumn months.[18] Despite 4 studies finding evidence for winter seasonality in this subgroup, there are some caveats. One study[19] found higher depression scores in winter in only 1 geographic subsample, while another found seasonal variation only in women.[20] Also, 1 study[21] found a modest effect size for the winter peak, while another found depression scores to be higher in winter than in autumn and spring, however, with no statistically significant difference compared to summer.[22]

Taken together, of these 19 studies investigating the prevalence of clinical depression and depressive symptoms, 9 report a winter peak, 2 report autumn peaks, 1 reports a spring peak, and 7 found no evidence of seasonality (Table 2). This review[9] included a further 3 studies that reported on antidepressant prescription rates. Of these 3 studies, 1 reported a winter peak.[23] The other 2 studies found peaks in autumn/spring[24] and summer/winter, respectively.[25] The remaining studies analyzed in the review by Øverland et al[9] related to hospital admission rates, which will be explored later in this article.

The earlier review by Magnusson[15] investigating seasonal distribution of mood disorders found stronger evidence of winter peaks to depressive symptoms. Of 10 included studies that utilized a cross-sectional approach to assess seasonal

Table 1. Summary of All Reviews

Author (year)	No. of Databases Searched (date range) and Included Studies	Factor(s) Examined	Diagnosis	Relevant Findings
Øverland et al (2020)[9]	7 (1975–2017) 41	Prevalence of depression, depressive symptoms, postpartum depression peak season, antidepressant prescriptions, hospital admissions and care	Unipolar depression, bipolar depression, postpartum depression	Trends toward winter peaks for depressive symptoms, depression prevalence, and postnatal depression Limited conclusive evidence for hospital admissions—some trends toward spring/autumn No clear pattern for prescription rates
Magnusson (2000)[15]	Unclear—at least 3 (1986–1998) 38	Prevalence of seasonal affective disorder and peak season thereof	Seasonal affective disorder	Strong evidence of winter peaks for depressive symptoms
Geoffroy et al (2014)[10]	2 (1974–2013) 51	Health service utilization (admission rates), seasonal pattern to symptoms	Bipolar affective disorder	Peaks for mania admissions in spring/summer and for depression in early winter; a smaller summer peak Trends toward winter peaks for depressive symptoms; no clear trends for manic or hypomanic symptoms
Tung et al (2022)[11]	3 (2010–2019) 5	Peak season of birth for postpartum depression	Postpartum depression	Meta-analysis with statistically significant increased rates of postpartum depression in winter births
Coimbra et al (2016)[12]	4 (1977–2014) 29	Peak season for suicide attempts	Suicide attempts	Significant evidence of spring and summer peaks for suicide attempts
Galvão et al (2018)[13]	7 (1979–2017) 50	Temporal distribution of suicides—including month and season	Completed suicide	Strong evidence for a spring and summer peak to suicides worldwide
Plöderl (2021)[14]	2 (2008–2020) 14	Temporal distribution of suicide risk	Completed suicide	Spring/summer peaks to suicide rates
Christodoulou et al (2012)[16]	2 (1979–2009) 113	Seasonal variation in suicide rates	Completed suicide	Mainly a spring and early summer peak to suicide rates, along with a smaller autumn peak; increased amplitude of seasonality for men and suicides by violent methods
Ajdacic-Gross et al (2010)[17]	1 (1959–2008) Unclear	Seasonal variation in suicide rates	Completed suicide	Trends toward spring/summer peaks for suicide; decreasing amplitude of this seasonality over time

Table 2. Analysis of Studies Included in Øverland et al[9] Relating to Seasonality of Depression in the Community

Study Category	No. of Studies Suggesting No Seasonality	No. of Studies Suggesting Increase in Winter	No. of Studies Suggesting Increase in Summer	No. of Studies Suggesting Increase in Autumn	No. of Studies Suggesting Increase in Spring
Depression prevalence	3	5	1	1	1
Depression symptoms	4	4	0	1	0
Total	7	9	1	2	1

variation in depressive symptoms, all but one found winter and autumn peaks to such symptoms. The only exclusion here was an Icelandic study[26] that reported no significant variation across the seasons.

The seasonal variation of mood specifically in people with bipolar disorder was also investigated in a systematic review by Geoffroy et al.[10] This review included 13 studies with 12 distinct data sets specifically investigating seasonal variation in symptoms in this cohort. These studies are quite heterogenous, with some specifically assessing the degree of seasonal variation and peak season for depressive, manic, and neurovegetative symptoms, while others solely investigated the prevalence of seasonal variation in mood in general in people with bipolar disorder without specifying peak seasons. With this in mind, despite many of the 8 studies that investigated seasonal variation in bipolar depression showing trends toward winter peaks, in only 3 did this reach statistical significance when compared to healthy controls (Table 3).[27–29] The remainder were unable to demonstrate statistically significant peaks,[30–33] although 1 study did find significant excess sleep in winter when compared to controls.[34] Another study[35] reported significant seasonal mood variation in people with bipolar depression reaching the same amplitude as those with seasonal depression; however, precisely in which season this peak occurred was not specified. Fewer of the included studies investigated seasonal variation in manic or hypomanic symptoms. However, of those that did assess seasonal variation in those symptoms, 1[28] found statistically significant peaks in autumn, while the remainder identified no significant seasonal variation (Table 3).[30–32]

Finally, postpartum depression (PPD) has also been identified as having some seasonal variability. This was specifically studied in a systematic review and meta-analysis

Table 3. Analysis of Studies Included in Geoffroy et al[10] Relating to Seasonality of Bipolar Disorder in the Community

Study Category	No. of Studies Suggesting No Seasonality	No. of Studies With an Unspecified Seasonal Peak	No. of Studies Suggesting Autumn Peak (statistically significant)	No. of Studies Suggesting Winter Peak (statistically significant)
Bipolar depression prevalence	4	1	0	3
Mania/hypomania prevalence	3	0	1	0
Total	7	1	1	3

Table 4. Analysis of Studies Included in øverland et al[9] Relating to Seasonality of Hospital Admissions for Depression

Study Category	No. of Studies Suggesting No Seasonality	No. of Studies Suggesting Increase in Winter	No. of Studies Suggesting Increase in Spring	No. of Studies Suggesting Bimodal Spring/Autumn Peak
Hospital admissions for depression	6	1	1	4

Table 5. Analysis of Studies Included in Geoffroy et al[10] Relating to Seasonality of Admissions for Bipolar Disorder

	No. of Studies Suggesting								
Study Category	No Seasonality	Winter	Summer	Autumn	Spring	Winter and Spring	Spring and Summer	Spring and Autumn	Summer and Winter
Admissions for mania	5	1	6	0	4	3	6	1	0
Admissions for depression	4	5	0	2	1	1	2	1	1

by Tung et al.[11] This review pooled data from seasons other than winter to investigate the difference between rates of PPD in winter births as compared to those in other seasons. This approach identified an increased risk of PPD after winter births compared to those in other seasons. The systematic review conducted by Øverland et al[9] also included a subgroup of studies related to PPD. Most of the studies included in this review[9] identified higher rates of PPD from births in either winter or autumn, similar to the meta-analysis by Tung et al.[11]

ED Presentations and Hospital Admissions

Regarding seasonality and ED psychiatric presentations, a systematic review by Coimbra et al[12] investigated the seasonality of suicide attempts both in general and in patients presenting to the ED. The results showed a worldwide spring and summer peak to both aspects of suicide attempts, with the number of suicide attempts presenting to the ED in spring and summer being 1.2–1.3 times higher than in winter. The magnitude of this effect further increased to 1.7 times higher in spring and summer when using more homogenous data solely relating to suicide attempts by self-poisoning. No identified systematic reviews of overall ED psychiatric presentations and their seasonality were identified.

Øverland et al[9] identified 12 studies analyzing seasonality of hospital admissions for depression. Of these, only 1 study found a seasonal peak in winter,[36] while 6 found no seasonality,[37–42] and the remaining 5 found either bimodal spring and autumn peaks[18,43–45] or a unimodal spring peak (Table 4).[46] However, these findings are limited in that several of the studies identifying seasonality outside of winter only analyzed data over the course of 1 year, and this aspect might be better analyzed using a longitudinal approach.

Geoffroy et al[10] analyzed the seasonality of hospital admissions for bipolar disorder and identified 32 studies. All the included studies except for 3 demonstrated statistically significant seasonal peaks (n = 29), which may be explained by small sample sizes in these studies.[47–49] For mania, seasonal peaks were predominately in the spring and summer months, while for depression an early winter peak and a smaller summer peak were observed (Table 5). Regarding mania, this peak results in between 7.4% and 16% more admissions in spring and summer.[50,51] In terms of bipolar depression, the degree of seasonal variation may contribute to up to 1.5 times more presentations in winter months.[52] These findings apply to both first onset and relapse episodes of bipolar disorder[53] and were observed worldwide and for both genders. However, a small number of studies[52,54–56] suggested that women are more likely to experience seasonality in bipolar disorder. It is also important to note that bipolar disorder with seasonal pattern is associated with a more severe clinical phenotype of rapid cycling, bipolar disorder type 2, comorbid eating disorders, and the total number of depressive episodes.[57] No systematic review of seasonality of hospital admissions for schizophrenia was identified.

Suicide

The most recent systematic review assessing the seasonality of suicide was conducted by Galvão et al[13] as part of a broader review of the temporal distribution of suicide. This comprehensive review included 45 studies across 26 countries. Of the 19 studies that specifically assessed seasonality, the majority found a peak in either spring or summer (13 studies[58–70]), while the remainder found no significant pattern (4 studies[71–74]) or found an autumn peak (1 study[64]) (Table 6). The final study[75] assessing suicide

Table 6. Analysis of Studies Included in Galvão et al[13] Relating to Seasonality of Suicide Rates

Study Category	No. Suggesting No Seasonality	No. Suggesting Autumn Peak	No. Suggesting Spring and Summer Peak	No. With Unspecified Peak
Suicide rates	4	1	13	1

seasonality reported a significant seasonal pattern without specifying when this peaked. Furthermore, 27 of the included studies analyzed the monthly distribution of suicide. Of these, 81.5% found a peak in a month corresponding with spring or summer. Importantly, the findings in this review[13] applied to both men and women, all age groups, people in rural and urban areas, varying religious affiliations, and a wide range of countries, suggesting a universal trend. Further analysis shows that the magnitude of this variation results in 11%–23% more suicides in spring and summer.[68] This pattern to seasonality for suicide was further affirmed by a more recent non-systematic literature review.[14]

The presence of a spring or summer peak to suicide was also identified in 2 earlier systematic reviews by Christodoulou et al[16] and Ajdacic-Gross et al.[17] While both found this trend, the former[16] also identified a smaller autumn peak in some countries, particularly among women. Both reviews also found that suicides by violent methods display a greater spring and summer peak, with Christodoulou et al[16] suggesting this subgroup displays a greater amplitude of seasonality, while Ajdacic-Gross and colleagues[17] found that seasonality was often only present in violent suicides compared to other methods. Furthermore, Christodoulou et al[16] also found a greater spring and summer peak in male suicides and in suicides committed by people with psychiatric disorders. Finally, one notable finding from the review by Ajdacic-Gross et al[17] was that the overall amplitude of seasonality has been decreasing in recent decades, which the authors attribute to an overall decrease in the prevalence of suicide by violent methods.

DISCUSSION

Seasonality has significant effects on mood and demand for behavioral and psychiatric health care. There is substantial evidence for a statistically significant spring and summer peak of suicide rates. ED self-harm–related presentations tend to correspond with this spring and summer seasonality. There is a clear spring and summer peak to admission rates for mania in people with bipolar disorder, while conversely for bipolar disorder depression there is a suggestion of a winter peak, but these patterns are not as marked for unipolar depression. There is evidence suggestive of winter peaks for depression, particularly depressive symptoms, in the community, which may be more pronounced among people with clinical depressive disorders. There is also some evidence for a winter trough in mood in people with bipolar disorder; however, this remains inconclusive. Overall, broad trends point toward a winter worsening of both bipolar (including hospital admissions) and unipolar depression but a clear spring and summer peak for ED self-harm–related presentations, mania-related hospital admissions, and suicide rates.

This review suggests that primary care services will likely experience increased winter activity related to depression, while ED self-harm–related presentations, hospitalizations for mania, and suicide rates will likely be increased in spring and summer. These findings are important to guide preventative activities, ensuring that resources are targeted toward the time of year when they will be most effective. While an understanding of the population-level trends in seasonality of service demand is important, clinicians should be aware that individuals will not always align with seasonal variations seen at the population level, even though there may be some interaction between individual psychology, biological factors, and social aspects that are more amenable to seasonal variation and intervention.

Multiple biopsychosocial factors have been suggested as potential mechanisms contributing to the seasonality of service demand. With regard to mood, some suggested factors include seasonal variations in melatonin and other hormones due to changing levels of daylight[9] and also social factors such as increased stress through work or scholarly activities over winter.[76] Seasonal variation in bipolar disorder is likely to have a significant biological component linked to disruptions in the circadian rhythm.[77] However, social rhythms are also a key factor in circadian rhythm control, with social factors also linked to the onset of mania.[77] With regard to seasonal variation in suicide rates, hormonal variation has also been suggested. The dichotomy between peak seasons of mood worsening and suicide rates may be explained by a similar mechanism to that of when starting an antidepressant, with an increase in energy levels and motivation preceding an increase in mood leading to increased suicide.[9] However, some doubt has been cast on this theory given the finding by White et al[78] that the seasonal effect on suicide rates remains when adjusting for daylight hours, which suggests contribution by other factors.

In this context, other social factors may contribute to seasonal variation in psychiatric disorders, and suicide rates in particular. Such a contribution was first suggested by Durkheim, who hypothesized that an increasing intensity of social activity during the warmer weather associated with spring and summer may drive this suicide-related seasonality by catalyzing interpersonal conflict.[5] More recently, the "broken promises" theory was also suggested, with times of new beginnings such as spring driving suicidal behavior when these new beginnings fail to deliver on an individual's expectations.[17] This theory, however, also seems unlikely given that seasonality in suicide is most pronounced with certain methods. Therefore, it could simply be that warmer weather increases access to violent methods of

suicide such as drowning and jumping.[17] This aligns with the impulsive nature of these methods, with impulsivity itself being a risk factor for suicide.[79] Spring and summer may exacerbate this aspect of suicide risk not only through access to these methods of suicide, but also through the aforementioned interpersonal conflict leading to impulsive decision making, which may be further worsened by other factors such as substance use. Various other factors have also been postulated to contribute to seasonality in suicide, such as variations in employment, family support, and substance use.[78]

While there is a relative lack of research into the seasonality of ED self-harm–related hospital presentations, it is likely that a similar range of biopsychosocial factors as described previously may be involved. Health policy and planning should take into account the substantial seasonal variation in mood, suicidal behavior, and service demand. Further research will be required to explore the findings of this review, particularly with regard to ED psychiatry presentations and hospital admissions, which would benefit from a specific systematic review. Future research can also investigate the possible etiologic mechanisms behind observed seasonal differences and possibly identify any modifiable social factors that may be driving psychiatry presentations.

While this research provides some insights into the seasonal patterns of various domains of psychiatric and behavioral health care utilization, there remains some limitations and areas for future research. First, while we have presented data on the seasonal epidemiology of service utilization, the mechanism behind these seasonal variations remains unknown and requires further research. Similarly, the peaks seen in spring/summer for ED presentations, psychiatric admissions, and suicide could represent a time lag effect, with onset of symptoms in winter months before a crescendo in the spring and summer months. This would be best investigated through a longitudinal cohort study rather than the cross-sectional studies reviewed here and might help further guide the best timing of early intervention. Finally, we were limited by a lack of data relating to seasonality correlating with ED psychiatric presentations and to a lesser extent hospital admissions. The domain of ED presentations and seasonality in particular lacks systematic reviews and would benefit from further research.

Submitted: August 12, 2022; accepted December 7, 2022.
Published online: May 25, 2023.
Relevant financial relationships: None.
Funding/support: None.

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