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Palmu, Raimo

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Seasonal changes in mood and behavior contribute to suicidality and worthlessness in a population-based study

Raimo Palmu^{a,b,*}, Seppo Koskinen^b, Timo Partonen^b

^a Department of Psychiatry, University of Helsinki and Helsinki University Hospital, P.O. Box 590 (Välskärinkatu 12), FI-00029, HUS, Finland

^b Department of Public Health and Welfare, Finnish Institute for Health and Welfare, P.O. Box 30 (Mannerheimintie 166), FI-00271, Helsinki, Finland

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ABSTRACT

Limited evidence suggests that the seasonal changes in mood and behavior may associate with suicidality and the feelings of worthlessness, but these associations have not been analyzed in large population-based data. A random sample of adults ($n = 4069$), representative of the general population living in Finland, attended a nationwide health examination survey. Seasonal variations (seasonality) in mood and behavior were analyzed with the six items of global seasonality score (GSS) and the experienced problem due to these variations. Their impact on suicidality as well as on the feelings of worthlessness were analyzed using logistic regression models. After adjusting for age and gender, the GSS, each of its six items and the experienced problem due to the seasonal variations in mood and behavior all showed separately a significant association with suicidality as well as with worthlessness. After further adjustment for the education level and region of residence, the GSS, its mood item and the experienced problem remained significantly associated with both suicidality and worthlessness. Seasonal variations in mood and behavior have a significant association with both suicidality and worthlessness.

1. Introduction

Deaths from suicide (Yu et al., 2020) as well as attempted suicides (Haukka et al., 2008) appear to follow a seasonal pattern. It is not known whether suicidal thoughts follow any seasonal pattern in a population. Suicide prevention is a challenge which needs new instruments to ease the identification of suicide risk.

Mental disorders including recurrent major depressive disorder and bipolar disorder follow a seasonal pattern and are therefore also known as seasonal affective disorder (Thompson et al., 1988; Kasper et al., 1989; for review, see Partonen and Lönnqvist, 1998). The original conceptualizations of seasonal affective disorder were eventually transformed into diagnostic criteria based on the Diagnostic and Statistical Manual of Mental Disorders and were first published in 1987 (for review, see Wehr and Rosenthal, 1989). In addition, season-bound exaggeration of illness has been observed in some other mental disorders as well, such as in eating disorders (Lam et al., 1996), insomnia (Ohayon and Partinen, 2002), and alcohol abuse or dependence (McGrath and Yahlia, 1993). These seasonal changes can be assessed with structured clinical interviews for diagnosis or screened with self-report questionnaires, such as the Seasonal Pattern Assessment

Questionnaire (SPAQ by Rosenthal et al., 1984) or the Seasonal Health Questionnaire (SHQ by Thompson and Cowan, 2001). The SPAQ yielding the global seasonality score (GSS) can be used for a measure of seasonality of mood in the general population (Mersch et al., 1999; Murray, 2003).

Some patients with seasonal affective disorder have suicidal thoughts (Partonen and Rosenthal, 2001; Kim et al., 2015), but deaths from suicide are rare among them (Sakamoto et al., 1995; Thompson et al., 1995; Schwartz et al., 1996; Graw et al., 1997). However, the seasonal changes in mood and behavior in relation to the feelings of worthlessness have not been studied earlier. Feeling oneself worthless seems to be important in psychological distress, depression, and suicidality. Of the depressive symptoms, worthlessness as well as recurrent thoughts of death contributed most significantly to worse levels of functional status in unipolar, bipolar and the first-episode depression (Anmella et al., 2020), and worthlessness was one of the three most central depressive symptoms in major depression disorder (Park and Kim, 2020) and the one which was most strongly associated with a history of suicide attempts in both men and women in the nationally representative data derived from an epidemiologic survey on alcohol and related conditions (Bolton et al., 2008). Earlier, we discovered that

* Corresponding author. Department of Psychiatry, University of Helsinki and Helsinki University Hospital, Helsinki, P.O. Box 590 (Välskärinkatu 12), FI-00029, HUS, Finland.

E-mail addresses: raimo.palmu@hus.fi, raimo.palmu@thl.fi (R. Palmu).

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the score on the GHQ-12 item 11 “Feeling oneself worthless” was significantly associated with suicidality in a nationwide study representative of the general adult population (Palmu et al., 2020a, 2020b).

To this end, we searched the PubMed database as of September 20, 2021 using the advanced search on “suicidality AND Seasonal Pattern Assessment Questionnaire” as well as “worthlessness AND Seasonal Pattern Assessment Questionnaire”. The search yielded that there is a gap in knowledge, whether there is a difference in suicidality and worthlessness between individuals with and those without the experienced problem due to the seasonal changes in mood and behavior. Thus, our aim was to address this knowledge gap. In specific, we analyzed whether either suicidality or worthlessness was associated with the seasonal variations in mood and behavior.

2. Methods

2.1. Study sample and participants

The Health 2011 Survey (Lundqvist and Mäki-Opas, 2016) is a follow-up study of the Health 2000 Survey (Heistaro, 2008). The invitation to take part in the Health 2011 Survey was sent to all persons (aged 29 or over in 2011) who had been included in the representative random sample of the national Health 2000 survey 11 years earlier ($n = 8135$) and were still alive and living in Finland as well as to a new random sample of persons aged 18–28 years ($n = 1994$). The age range of the sample was 18–101 years. The data were collected in 60 locations all over the country between August 2011 and June 2012. The participation rate was 74% for those aged 29 years or older and 42% for the new cohort of adults aged from 18 to 28 years. The Health 2011 Survey is representative of the adult population living in Finland in 2011.

The study was approved by the Coordinating Ethics Committee of the Hospital District of Helsinki and Uusimaa (HUS, reference 45/13/03/00/11). After complete description of the study to the subjects, written informed consent was obtained.

2.2. Assessment of seasonal variations in mood and behavior

The seasonal variations in mood and behavior were assessed for 4175 participants. These were measured with a self-rating Global Seasonality Score (GSS), which is part of the Seasonal Pattern Assessment Questionnaire (SPAQ) (Rosenthal et al., 1984). The GSS asks the seasonal variations in sleep duration, social activity, mood, weight, appetite, and energy level in retrospect. Each item was a Likert-like scale, which we modified to be scored from 0 (no variation) to 3 (marked variation), yielding the total sum score from 0 to 18. The higher the GSS is, the higher the degree of mood seasonality is. In addition to the six items of the GSS, there was one item about the experience on the seasonal variations as a problem, which we modified to be scored from 0 (no problem) to 4 (severe problem).

2.3. Assessment of suicidality

The suicidality was assessed for 4518 participants. Younger adults, aged 18–28 years, were asked to answer to two specific questions concerning suicidality. Both questions were scored on a Likert-like scale. The first question was “Have you ever seriously thought about committing suicide”. The four response alternatives were: “Never”, “Yes, last time was less than six months ago”, “Yes, last time was from 6 to 12 months ago”, “Yes, last time was more than 12 months ago”. The second question was “Have you ever attempted suicide, planned or unplanned”. Three alternative answers were: “Never”, “Yes, once” and “Yes, more than once, altogether [the number of] times”. A person was defined as “not suicidal”, if the answer to both questions was “Never”. Persons giving any other answer to either question were defined as suicidal.

For older adults, aged 29 years or older, we used a modified BDI-13, based on the original BDI-21 (Beck et al., 1961), in which the item of

suicidality (“Self-punitive Wishes”, hereafter referred as the item 7) had five response alternatives (1–5) as follows: 1 = “I have never had any thoughts of harming myself”, 2 = “I have thoughts of harming myself but I would not carry them out”, 3 = “I feel I would be better off dead”, 4 = “I feel my family would be better off if I were dead”, and 5 = “I wish I were dead”. Persons giving any other answer than “I have never had any thoughts of harming myself” were defined as suicidal.

2.4. Assessment of worthlessness

The feelings of worthlessness were assessed for 5386 participants. Current psychological distress was assessed using the 12-item version of the General Health Questionnaire (GHQ-12; Goldberg, 1972), an important screening instrument for detecting psychological distress among the general population (Pini et al., 1997). It includes 12 questions assessing symptoms commonly related to depression as well as general functioning, e.g., ability to face problems and make decisions. All items have a 4-point scoring system ranging from a “better/healthier than normal” option, through a “same as usual” and a “worse/more than usual” to a “much worse/more than usual” option. However, since the scores on the GHQ-12 item 11 (“Feeling oneself worthless”) tend to associate strongly with suicidality (Palmu et al., 2020a, 2020b), we focused here on analysis of this item only. We scored it using a 0–1–1–1–scoring, so that the “better/healthier than normal” response was scored as 0, and the “same as usual”, “worse/more than usual” and “much worse/more than usual” responses were scored as 1.

2.5. Statistical analysis

The complete data on the seasonal variations in mood and behavior (yielding the GSS), suicidality and worthlessness were derived from 4069 participants and used for the analyses. In the logistic regression models, which met the application conditions, the variables indicating suicidality and worthlessness were the dependent outcome variables, and the seasonal variations in mood and behavior as well as the experienced problem due to these variations were independent explanatory variables. First, we calculated the univariate models, for which age and gender were adjusted. Finally, for the multivariate models, age, gender, education level, and region of residence were adjusted. The IBM SPSS Statistics for Windows, version 27, software (International Business Machines Corporation, Armonk, NY, USA) was used for the statistical analyses.

3. Results

Descriptive data on the sample are presented in Table 1. In the univariate models, the GSS, each of the six items, and the experienced problem all showed separately a significant association with suicidality (p -values from <0.001 to 0.004, odds ratios from 1.115 to 1.846; see Table 2). In the multivariate models, the association of suicidality with the GSS, the item for mood, and the experienced problem remained significant (these p -values of <0.001 ; see Table 2).

In the univariate models, the GSS, each of the six items, and the experienced problem all showed separately a significant association with worthlessness (all p -values of <0.001 , odds ratios from 1.186 to 2.030; see Table 3). In the multivariate models, the association of worthlessness with the GSS, the item for mood, and the experienced problem remained significant (p -values of <0.001 ; see Table 3).

4. Discussion

In this population-based sample, which was representative of the general population aged 18 years and older living in Finland, we found robust associations of seasonal variations in mood and behavior with suicidality and the feelings of worthlessness. The global seasonality score, each of its six items, and the experienced problem due to these

Table 1
Descriptive data on the study sample (n = 4069).

	n	%
Gender		
female	2290	56.3
male	1779	43.7
Education level ^a		
basic	916	22.5
upper secondary	1382	34.0
higher	1725	42.4
Region of residence		
Helsinki region (South)	1326	32.6
Turku region (West)	567	13.9
Tampere region (central)	886	21.8
Kuopio region (East)	701	17.2
Oulu region (North)	589	14.5
Suicidality, yes	451	11.1
Worthlessness, yes	324	8.0
	Mean	Std. deviation
Age, years	55.48	13.89
Global Seasonality Score (0–18)	4.56	3.10
Sleep duration (0–3)	0.90	0.72
Social activity (0–3)	0.91	0.77
Mood (0–3)	0.88	0.78
Weight (0–3)	0.53	0.65
Appetite (0–3)	0.44	0.63
Energy level (0–3)	0.91	0.76
Experienced problem (0–4) ^b	1.29	0.72

^a n = 4023.

^b n = 4068.

Table 2
Suicidality explained by the seasonal variations in mood and behavior in the population-based Health 2011 Study in Finland.

Variable	Beta	Suicidality		p ^a	p ^b
		OR	95% CI		
Global Seasonality Score	0.109	1.115	1.082 to 1.150	<0.001	<0.001
Sleep duration	0.262	1.299	1.140 to 1.480	<0.001	0.576
Social activity	0.288	1.334	1.179 to 1.510	<0.001	0.320
Mood	0.577	1.781	1.579 to 2.009	<0.001	<0.001
Weight	0.211	1.234	1.068 to 1.427	0.004	0.910
Appetite	0.223	1.250	1.081 to 1.445	0.003	0.458
Energy level	0.421	1.523	1.347 to 1.723	<0.001	0.717
Experienced problem	0.613	1.846	1.622 to 2.102	<0.001	<0.001

Abbreviations: OR = odds ratio, CI = confidence interval.

^a p-values for the univariate models adjusted for age and gender.

^b p-values for the multivariate models adjusted for age, gender, level of education, and region of residence.

seasonal variations in mood and behavior were associated with suicidal thoughts as well as with worthlessness. The association of seasonal variations in mood and behavior with suicidal thoughts nor that with worthlessness has not been reported earlier.

Although the association of seasonal variations in mood and behavior with suicidal thoughts has not been reported in earlier studies, there is a seasonal pattern not only in deaths from suicide but also in attempted suicides in Finland as well as in other countries (Haukka et al., 2008; Yu et al., 2020). For the assessment of suicidality, we combined the direct questions of suicidal thoughts and attempted suicide, and the score on the item of suicidality from a validated self-report instrument (BDI-13, item 7). Of note, in the original BDI-21 (Beck et al.,

Table 3
Worthlessness explained by the seasonal variations in mood and behavior in the population-based Health 2011 Study in Finland.

Variable	Beta	Worthlessness		p ^a	p ^b
		OR	95% CI		
Global Seasonality Score	0.170	1.186	1.146 to 1.227	<0.001	<0.001
Sleep duration	0.433	1.541	1.329 to 1.788	<0.001	0.722
Social activity	0.431	1.539	1.336 to 1.77.2	<0.001	0.433
Mood	0.708	2.030	1.773 to 2.324	<0.001	<0.001
Weight	0.360	1.433	1.224 to 1.679	<0.001	0.738
Appetite	0.477	1.611	1.378 to 1.882	<0.001	0.332
Energy level	0.643	1.903	1.656 to 2.186	<0.001	0.126
Experienced problem	0.689	1.992	1.727 to 2.297	<0.001	<0.001

Abbreviations: OR = odds ratio, CI = confidence interval.

^a p-values for the univariate models adjusted for age and gender.

^b p-values for the multivariate models adjusted for age, gender, level of education, and region of residence.

1961), the item 9 (“Self-punitive wishes”) had four alternatives for answer (0–3) but the alternative number 2 had three different options as follows: 2a = “I feel I would be better off dead”, 2b = “I have definite plans about committing suicide”, and 2c = “I feel my family would be better off if I were dead”. The answer “I would kill myself if I could” was scored as 3.

The seasonal variations in mood and behavior in relation to the feelings of worthlessness have not been studied earlier. However, the feelings of worthlessness are common in a general population, e.g., in the USA (García-Velázquez et al., 2021). Furthermore, the feelings of worthlessness are known to associate with suicidality (Bolton et al., 2008). We corroborated this association earlier by discovering that the score on the GHQ-12 item 11, with which “Feeling oneself worthless” is assessed, was significantly associated with suicidality among the adult general population living in Finland (Palmu et al., 2020a, 2020b). Thus, the assessment of seasonal variations in mood and behavior appears to bear information on suicidality as well and is therefore relevant not only in the identifying of suicide risk in clinical practice, but also in the implementation of suicide prevention measures.

Using the global seasonality score, its six contributing items and the experienced problem due to these seasonal variations in mood and behavior, we found robust associations with suicidality as well as with worthlessness in the regression models adjusted for age, gender, the level of education, and the region of residence. The global seasonality score has been validated as a measure of seasonality of mood in earlier studies (Magnusson et al., 1997), whereas the item of the problem experienced due to the seasonal variations demarcates poorly seasonal affective disorder from its subsyndromal form and thereby has a poor case-finding ability (Magnusson, 1996; Mersch et al., 2004). Furthermore, there are certainly factors which could act as mediators between mood seasonality and suicidal behavior, such as insomnia, eating disorders, physical activity, or social support, and thus need to be addressed in future studies to elucidate their relationships more in detail.

Using the GHQ-12 in screening for not only psychological distress but also suicidality might be recommended. In addition to it, the assessment of the magnitude of the problem experienced due to the seasonal variations in mood and behavior, or the assessment of the mood item of the global seasonality score, could help in screening suicide risk. A brief assessment of this kind should be easy to administer by health care professionals at any appointment. The preventing aspects were

already raised in the pioneering study on participants aged 10–25 years, showing that women in the beginning of their reproductive years were more sensitive to the seasonal variations in mood and behavior (Tonetti et al., 2007).

Strengths of this study include that it was based on a population-based sample and through its sampling strategy was representative of the general population, aged 18 years and older, living in Finland, a high-income Nordic country with approximately 5.55 million inhabitants. As the main measures of suicidality, we used a binary variable which was based on the direct questions of suicidal thoughts and attempted suicide, and on one item of a validated self-report scale (BDI-13, item 7). For the assessment of the feelings of worthlessness, the score on one item of a validated self-report scale (GHQ-12, item 11) was used. Furthermore, for measurement of the seasonal variations in mood and behavior, we applied the widely used instrument (GSS) which is part of a self-report questionnaire (SPAQ) and has been validated in studies on not only patient populations but also general populations.

However, our study has also some limitations. It was based on self-reported data which were collected with a household interview together with a set of questionnaires. In addition, the study design was a cross-sectional one, so we were not able to analyze the causal relationship of seasonal variations in mood and behavior with suicidality nor with the feelings of worthlessness. It is not only a limitation that subjective data have been collected, but the simplicity of the selected measures. For example, there are much more sensitive self-assessed suicide risk questionnaires. However, the data were collected as part of a population-based epidemiological study in which detailed questionnaires of suicidality could not be included. Further, we were not able to collect data on the behavioral trait of morningness-eveningness nor directly on the circadian rhythms, of which it is known that there is a relationship of the robust amplitude with negative aspects of mental health (Díaz-Morales et al., 2017; Ferguson et al., 2018). The diurnal preference emerging from the circadian rhythm dynamics may however contribute to the seasonal variations in mood and behavior (Hofman and Swaab, 1993; Partonen, 2021).

In conclusion, seasonal variations in mood and behavior were significantly associated with both suicidality and worthlessness.

Author contributions

Raimo Palmu: Conceptualization; Data curation; Formal analysis; Investigation; Roles/Writing - original draft; Writing - review & editing.

Seppo Koskinen: Conceptualization; Data curation; Funding acquisition; Methodology; Project administration; Resources.

Timo Partonen: Conceptualization; Data curation; Formal analysis; Investigation; Methodology; Project administration; Resources; Supervision; Validation; Roles/Writing - original draft; Writing - review & editing.

Declarations of competing interest

None.

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