Seasonal affective disorder and latitude

Mersch, PPA; Middendorp, HM; Bouhuys, Antoinette; Beersma, DGM; van den Hoofdakker, RH; Middendorp, Hermine M.

Published in:
Journal of Affective Disorders

DOI:
10.1016/S0165-0327(98)00097-4

Publication date:
1999

ELSEVIER

Journal of Affective Disorders 53 (1999) 35–48

JOURNAL OF AFFECTIVE DISORDERS

Research report

Seasonal affective disorder and latitude: a review of the literature

Peter Paul A. Mersch*, Hermine M. Middendorp, Antoinette L. Bouhuys, Domien G.M. Beersma, Rutger H. van den Hoofdakker

Department of Biological Psychiatry, University Hospital Groningen, P.O. Box 30001, 9700 RB Groningen, The Netherlands

Received 18 December 1997; received in revised form 10 May 1998; accepted 11 May 1998

Abstract

Background: The aim of the study is to investigate the relationship between the prevalence of SAD and latitude. *Methods*: An overview of the epidemiological literature on the prevalence of SAD is given and studies relevant for the latitudinal dependency of prevalence will be analyzed and discussed. *Results*: The mean prevalence of SAD is two times higher in North America compared to Europe. Over all prevalence studies, the correlation between prevalence and latitude was not significant. A significant positive correlation was found between prevalence and latitude in North America. For Europe there was a trend in the same direction. *Conclusions*: The influence of latitude on prevalence seems to be small and other factors like climate, genetic vulnerability and social–cultural context can be expected to play a more important role. Additional controlled studies taking these factors into account are necessary to identify their influence.

Keywords: Seasonal affective disorder (SAD); Latitude; Epidemiology; Prevalence; North America; Europe; Climate; Genetic vulnerability; Social–cultural context

1. Introduction

By definition, seasonal affective disorder (SAD) is associated with (the changing of) the seasons (Rosenthal et al., 1984). A major hypothesis is that SAD is triggered by photoperiod variation. Since photoperiod variation over the seasons is larger closer to the poles, it is hypothesized that with an increase in latitude there is an increase in the prevalence of SAD. This association has been suggested by the outcome of two studies in the USA and Norway (Lingjaerde et al., 1986; Potkin et al., 1986). Although both studies have their methodological limitations, they have stimulated more research into the relationship between prevalence and latitude. Since then, the prevalence of SAD has been explored in a number of studies, mainly in North America and Europe.

In the present report the importance of the results of these studies for the latitude–prevalence issue will be discussed. First, studies will be discussed that either investigated both prevalence and latitude

*Corresponding author.

0165-0327/99/$ – see front matter
PII: S0165-0327(98)00097-4

directly or studies that did not investigate prevalence per se, but within specific sub-populations the relationship of SAD or depressive symptoms with latitude. Second, analysis will be performed on prevalence studies at different latitudes. Since the legitimacy of comparing figures from different studies depends on the comparability of the applied methodology and assessment instruments, this aspect will be given some consideration. For the sake of conciseness the characteristics of the studies are not extensively discussed but are summarized in tables for the different continents.

1.1. Studies on prevalence and latitude

In the Potkin et al. (1986) and the Lingjaerde et al. (1986) studies a questionnaire consisting of 15 symptoms of SAD was published in nationwide newspapers in the USA and Norway with the request to return the questionnaire if eight or more symptoms were present (caseness SAD). Both studies showed a positive correlation between latitude and prevalence. This result is merely indicative. The characteristics of the readers of the newspaper are unknown and may have been different in different parts of the country. Also, it is unknown how many of the subjects who met the criteria of SAD (eight symptoms or more) returned their questionnaire; these percentages may have differed across the country due to cultural differences. Finally, since the questionnaire used in these studies was not validated, the lack of direct clinical assessment is more important in these studies than in those using a validated instrument.

Rosen et al. (1990) studied the prevalence at four locations in the USA (see Tables 1–3 for a description of the different studies), using the same methods.

Positive correlations were found between the prevalence of winter-SAD, and winter-SAD and subsyndromal-SAD (S-SAD; see methodological issues) combined, and latitude. Recently, Levitt and Boyle (1997) studied the prevalence of SAD in the Province of Ontario, Canada, across eight strata of 1° latitude (from 42°N to 50°N). They found no association between latitude and prevalence. In a study in Italy (Muscettola et al., 1995) the prevalence rates at three of the five locations at which the study was performed were compared: Catanzaro (39°N), Napoli (41°N), and Trieste (46°N). The correlation was in the unexpected direction ($r = -0.50$). The results in the latter study may be biased, however, by the low response rates (overall 13.6%). Nevertheless, as the authors claim, comparison between the three locations in the study may have some value since the response rates were approximately the same.

In Japan (Sakamoto et al., 1993) the prevalence of SAD was assessed among patients with a mood disorder who contacted 53 outpatient university psychiatric clinics in Japan for the first time between 1 September 1990 and 31 March 1991. The clinics were located between 26°N and 44°N. The results show a nonsignificant correlation between prevalence and latitude (Spearman's $r = 0.33$, $P < 0.10$). Okawa et al. (1996) studied seasonal variation in six cities in Japan at latitudes ranging from 32°N to 43°N. The global seasonality score showed a significant correlation with latitude. Partonen et al. (1993) assessed the frequency of depressive symptoms among 1000 subjects (801 women, 199 men), all employees of a nationwide bank in Finland. The SIGH-SAD self-rating scale was returned by 486 subjects, living between 60°N and 70°N. The results showed that depressive symptoms were not more common at higher latitudes than at lower latitudes. In a study among the winter-over personnel of three antarctic stations (from 64°S to 90°S), Palinkas et al. (1996) did not find an association between seasonality and latitude. The sample was too small ($n = 87$) and the stay on Antarctica was too short to draw conclusions on prevalence. Finally, the prevalence of seasonal symptoms in relation to latitude was studied in children (age range, 9–12 years) by Carskadon and Acebo (1993). Questionnaires were sent to teachers of 78 schools across the USA, who asked the parents of the children to complete them. Six questions concerning seasonal symptoms were taken from the SPAQ and adapted for this occasion. The schools were located in three geographic zones: a northern zone (>42°N), a central zone (between 36°N and 42°N) and a southern zone (<36°N). The results showed a significant higher incidence of seasonal symptoms in the winter in the northern and central zones versus the southern zone.

The conclusion from this overview is that, although confirmed by some studies, the evidence in

favor of a latitude–prevalence hypothesis is not conclusive.

Another approach is to compare the results of the different prevalence studies in relation to the latitudes at which they were performed. For a valid comparison it is necessary that the studies share a comparable and sound methodology. Therefore, some methodological issues concerning the prevalence studies will be discussed first.

1.2. Methodological issues

In all studies presented in Tables 1–3 (except the Potkin et al. (1986), the Lingjaerde et al. (1986) and the Partonen et al. (1993) studies) the same assessment instrument was used: the Seasonal Pattern Assessment Questionnaire (SPAQ; Rosenthal et al., 1987). This facilitates comparison of the results of the different studies. The criteria for SAD on the SPAQ have been formulated in the Kasper et al. (1989a) study and are based on data from 168 SAD patients (Kasper et al., 1989a; Hardin et al., 1991). The SPAQ applies three criteria for SAD, which are presented in Table 1 in the study by Kasper et al., 1989a). The first is based on the Global Seasonality (GS) scale, providing a composite measure for change of mood, social activities, appetite, sleep, weight and energy across the seasons. Item scales range from (0) 'no change' to (4) 'extremely marked change'. Thus, the total scale ranges from 0 to 24. The suggested cut-off score for caseness on this criterion is 10 for (telephone) interviews and 11 for the paper and pencil method.

A second criterion for SAD is based on one question, i.e. whether seasonal changes are considered a problem. The response possibilities are 0 = no problem, 1 = a mild problem, 2 = a moderate problem, 3 = a marked problem, 4 = a severe problem, and 5 = a disabling problem. A score of at least 2 is necessary to reach the SAD threshold.

The final criterion is the 'window', i.e. the time interval within which the problems should recur. The timing of the problems is determined by asking what months subjects feel worst. The width of the window varies across studies (see Tables 1–3), and may thus be a confounding factor.

Subsyndromal-SAD (S-SAD) (Kasper et al., 1989b) is defined as a cluster of seasonal complaints, which are not severe enough to allow for a diagnosis of SAD. The prevalence of S-SAD will not be discussed since there is confusion about the second set of the criteria: a GS score of 8 or 9 (9 or 10 for the self-report method) ''and seasonal changes are either a problem or not'' (Kasper et al., 1989a; p. 829). In some studies this criterion was not followed (Terman, 1988; Rosen et al., 1990; Booker and Hellekson, 1992; Hagfors et al., 1992; Muscettola et al., 1995) and changed into at least mild problems with the changes of season. In view of the way the criteria are formulated, this latter definition would indeed make more sense. It is clear that prevalence rates for S-SAD are influenced by the use of different criteria.

Different sampling methods are employed. The most reliable method is the drawing of a random sample of the general population from community registers (Magnusson and Stefansson, 1993; Mersch et al., 1995, 1998). In this case systematic sampling error is avoided. A second method is the random selection of subjects from the telephone directory (Terman, 1988; Rosen et al., 1990; Muscettola et al., 1995). In this case there is a risk of systematic error, because people without a telephone are excluded from the sample. Moreover, some people with a telephone are not listed in the directory. Kasper et al. (1989a) employed an elegant method to reduce the latter chance of error by random number dialling, a method also used by Levitt and Boyle (1997).

A method particularly sensitive to sampling bias is the study of subgroups of the population (Ito et al., 1992; Magnusson and Axelsson, 1993; Partonen et al., 1993; Ozaki et al., 1995; Eagles et al., 1996; Hedge and Woodson, 1996; Madden et al., 1996). Especially the selection of subjects from companies is questionable, since it is not likely that organisations select their employees randomly. Furthermore, bias as a consequence of the illness may influence the results. In a study in The Netherlands, respondents who met the criteria of SAD were significantly more often unemployed or on sick leave (Mersch et al., 1998). Moreover, concern with the protection of their privacy towards the employers may bias the ratings of company employees. For these reasons the seven above-mentioned studies are left out of the comparison. Since the study on children by Swedo et al. (1995) is obviously not a representative sample of

Table 1
Overview of prevalence studies on SAD in North America

Study	Location (latitude)	Month	Method/ sample	Selection criteria	No. of respondents (%)	Instruments	Criteria	Prevalence	Validation	Additional conclusions
Potkin et al. (1986)	32 states across the USA (28°N–48°N)	Mar.	Newspaper article and questionnaire	Readers of a nationwide newspaper	—	15 symptoms (yes/no)	SAD ≥ 8	—	No	Prevalence of SAD correlates with latitude, sunshine, cloudiness and temperature.
Kasper et al. (1989a)	Maryland, Washington DC (39°N)	Nov.	Telephone survey; random dialling	Age, ≥ 21 years Female, 53%; at least 3 years in county	416 (92%)	SPAQ	SAD: GS ≥ 10 and seasonal problems ≥ 2 S-SAD: GS ≥ 10 and seasonal problems = 0 or 1, or, GS = 8 or 9 and seasonal problems ≥ 0 Both SAD and S-SAD: SAD-win. (worst in Dec./Jan./Feb.) or SAD-sum. (worst in June/July/Aug.	SAD-winter: 4.3% SAD-summer: 0.7% S-SAD-winter: 13.5% No figures for summer S-SAD were given. Mean GS: 5.43 (S.D. = 3.9) Changes with the seasons are a problem: 27%	40 respondents (9.6%) interviewed with the SCID. Selection of subjects on the basis of the whole GS range. SAD: 50% false neg. ?false-positive S-SAD: 64% false-negative ?false-positive Conclusion: SPAQ tends to underestimate SAD.	Women between 21 and 40 years of age have higher GS ratings than men or older women. Three to four times more women than men meet the SPAQ criteria for winter SAD.
Rosen et al. (1990) and Terman (1988) (New York)	Sarasota (27°N)	Dec./Mar. Dec./Mar.	Mail out; telephone directory	No age range was given Authors tried to balance the male/female ratio	462 (46.2%)	SPAQ	The 'Kasper criteria' are used with two differences: (1) The window is limited to two months: Jan. and Feb. for a winter pattern and July and Aug. for a summer pattern. (2) A GS of 9 or 10 for S-SAD with *at least mild* problems with seasonal changes, instead of *a problem or not* in the Kasper study. Since no month criterion for S-SAD was defined, no differentiation between winter and summer S-SAD is possible.	SAD-win.: 1.4% SAD-sum.: 1.2% S-SAD: 2.6% LSM GS: 6.1 Changes with the seasons are a problem: 13.5%	No	Significant correlations between SAD and latitude and between SAD + S-SAD and latitude. Also after correction for age in most age groups.
	Montgomery County (39°N)	Dec./Mar.			605 (60.5%)			SAD-win.: 6.3% SAD-sum.: 1.0% S-SAD: 10.4% LSM GS: 6.7 Changes with the seasons are a problem: 22.0%		68% of SAD subjects was female (across locations). Negative correlation between GS score and age for both men and women.
	New York (40°N)	Dec./Mar.			203 (50.1%)			SAD-win.: 4.7% SAD-sum.: 3.1% S-SAD: 12.4% LSM GS: 7.4 Changes with the seasons are a problem: 24.2%		
	Nashua (42.5°N)	Dec./Mar			401 (30.1%)			SAD-win.: 9.7% SAD-sum.: 0.5% S-SAD: 11.0% LSM GS: 7.1 Changes with the seasons are a problem: 26.1%		

Booker and Hellekson (1992)	Fairbanks, Alaska (64°N)	Jan./Mar.	Interviews at home or by telephone; random sample of the population. The selection method was not specified.	Age: ≥ 21 years Subjects living in Alaska for at least 3 years No subjects living in institutions (incl. military bases, university campuses)	283 (78.6%)	SPAQ CES-D	Compared to Kasper et al. (9) a higher GS threshold was used (≥ 11). Figures for the lower threshold are given between brackets. SAD: GS ≥ 11 (10) and seasonal problems ≥ 2 S-SAD: GS ≥ 11 (10) and seasonal problems = 0 or 1, or GS 9 or 10 (8 or 9) and seasonal problems = 1	SAD: 9.2% (9.9%) S-SAD: 19.1% (24.0%) No distinction between winter and summer pattern was made No data on GS or 'problems with seasons'	No	Subjects who met the SAD criteria were younger and more often female (69.2%). SAD and S-SAD subjects had higher depression scores on the CES-D than the group without SAD or S-SAD.
Magnusson and Axelsson (1993)	Interlake district Canada (50.5°N)	?	Mail out; random sub-group of Icelandic descendants (n = 600)	Icelandic descendants Age: 20–74 years	252 (82%)	SPAQ	See Magnusson and Stefansson (1993) (Table 2)	SAD-win.: 1.2% SAD-sum.: 0.4% S-SAD-win: 3.3% S-SAD-sum: 0.0% Mean GS: 4.9 (S.D. = 3.4)	No	Prevalence rates of SAD and S-SAD in the Interlake district were significantly lower than in north-eastern USA and nonsignificantly lower than in Iceland.
Hedge and Woodson (1996)	Austin, Texas (30°N)	Winter months	Mail out/ hand out; sample of University staff and students	No	Staff: 193 (39%) Students: 216 (99%)	SPAQ	See 'Kasper criteria'	Winter-SAD: 3.7% Winter S-SAD: 17.8% Mean GS-score: 7.43	No	Women experience significantly more seasonal variation than men and younger people experience more variation than older people.
Levitt and Boyle (1997)	Province of Ontario, Canada (42°N–50°N)	—	Telephone Interview; random number dialling	Living at least 3 years in area At least 20 years of age	1605 (82%) 59% female	DSM-IV diagnosis after interview. SPAQ items were incuded	DSM-IV diagnosis SAD: 1.7% SPAQ diagnosis SAD: 7.4%	SAD prevalence figures and GS-score across eight strata of 1° had no association with latitude	Yes	
Swedo et al. (1995)	Washington, DC (39°N)	Sept.	Self-report: at school under supervision	Age: 9–19 years Sex: 50/50	1871 (82.5%)	SPAQ (modified version)	SAD: GS-score (range 0–40) ≥ 18 and seasonal problems (range 0–4) ≥ 2 Criteria are based on patient material. No S-SAD and no month criterion defined.	SAD: 3.3%	No	No significant difference between number of male and female SAD subjects. SAD increased with age (grade) with a peak between grade 10 and 13. For girls there was a significant increase of SAD in postpuberty.

Table 2
Overview of prevalence studies on SAD in Europe

Study	Location (latitude)	Month	Method / sample	Selection criteria	No. of respondents (%)	Instruments	Criteria	Prevalence	Validation	Additional conclusions
Lingjaerde et al. (1986)	Norway (58°N–71°N)	?	Newspaper article and questionnaire	Readers of a nationwide newspaper	—	15 symptoms (yes/no), see Potkin et al. (1986)	SAD ≥ 8	—	No	Relatively more people with SAD in the North than in the south.
Hagfors et al. (1992)	Finland (60°N–70°N)	Jan./Feb.	Telephone survey; representative sample	?	1800 (88%)	SPAQ CES-D	See 'Kasper criteria' (Table 1)	SAD: 3.4% S-SAD: 12.6% Changes with the seasons are a problem: 15.4%	No	—
Wirz-Justice et al. (1992)	Switzerland (47°N)	?	Telephone survey	Representative sample of the population	989 (?)	SPAQ	See 'Kasper criteria' (Table 1)	SAD: 2.2% S-SAD: 8.9% Mean GS score: 4.1 No distinction between winter and summer pattern	No	SAD: 69% female No correlation between 'seasonal problems' and living in sunny or overcast regions or urban or rural domicile
Magnusson and Stefansson (1993)	Iceland (62°N–67°N)	Spring	Mail out; National Register	Age: 17–67 years	587 (61%)	SPAQ	See Rosen et al. (1990), with the exception that for S-SAD the same window was used as for SAD	SAD-win.: 3.8% SAD-sum.: 0.0% S-SAD-win: 7.5% S-SAD-sum: 0.0% Mean GS: 5.5 (S.D. = 4.2)	60 subjects were interviewed with a structured DSM-III-R interview (DIS) and the SIGH-SAD. Conclusion: the SPAQ differentiated well between subjects with and without SAD, but less well between SAD and S-SAD	SAD/S-SAD (combined) were significantly more often female and young. No differences in residency (urban versus rural), employment and marital status.
Partonen et al. (1993)	Finland (60°N–70°N)	Nov./May (depressed subjects only)	Mail out; employees of a nationwide bank	801 women/199 men Age of respondents: 20–61 years Balanced to population density of geographical area	486 (48.6%)	SIGH-SAD-SR	Caseness: HDRS score ≥ 19	54 depressed cases After reassessment: seasonal depression: $n = 23$ nonseasonal depression: $n = 16$ nonresponsive: $n = 13$	Six subjects with seasonal depression were interviewed. Four had winter depression.	Female subjects more depressed than male subjects Depressive symptoms were independent of latitude. No correlation of depression score with age or body-mass

Hagfors et al. (1995)	Finland (60°N–70°N)	Dec.	Mail out; random sample	Age: 17–60 years	1200 (sent out) 3010 (sent out)	SPAQ CES-D	See 'Kasper criteria' (Table 1)	SAD: 7.1% S-SAD: 11.8%	No	Authors suggest genetic factors to explain the
	Sweden (55°N–69°N)	Dec.			Total response rate: ±55%			SAD: 3.9% S-SAD: 13.9% No distinction between winter and summer pattern		differences between the prevalence rates of Sweden and Finland.
Muscettola et al. (1995)	Italy: Catanzaro (38°55′N)	Jan./Feb.	Mail out; telephone directory	Sex: sent to 50% male and 50%	138 (13.8%)	SPAQ	SAD: GS ≥ 11 and seasonal problems ≥ 2 SAD-win.: feeling worst in Jan./Feb.	SAD-win.: 3.6% SAD-sum.: 0.0% S-SAD: 5.1%	No	GS-score significantly higher for females than for males.
	Capri (40°34′N)			female names Overall male/female	50 (10.0%)		SAD-sum.: feeling worst in July/Aug. S-SAD:	SAD-win.: 2.0% SAD-sum.: 10.0% S-SAD: 10.0%		Small negative correlations between GS-score and age
	Napoli (40°45′N)			proportion of response: 60/40	174 (17.4%)		GS = 9 or 10 and seasonal problems ≥ 1 and	SAD-win.: 6.3% SAD-sum.: 2.3% S-SAD: 4.6%		for both men and women. No positive correlation
	Calvi (41°04′N)				60 (12.0%)		feeling worst in Jan./Feb. No summer S-SAD	SAD-win.: 5.0% SAD-sum.: 1.7% S-SAD: 6.7%		between latitude and prevalence of SAD.
	Trieste (45°40′N)				121 (12.1%)			SAD-win.: 2.5% SAD-sum.: 0.9% S-SAD: 1.7%		
Mersch et al. (1998)	The Netherlands (northern provinces) (53°N)	Mar. 1993–Mar. 1994 400 (+2) question-naires each month during 13 months	Mail out; random from community registers	Age: 18–65 years Male/female: 50/50% Representative of community size in The Netherlands	2819 (53.9%)	SPAQ CES-D	SAD: GS ≥ 11 and seasonal problems ≥ 2 S-SAD: GS ≥ 11 and seasonal problems = 0 or 1, or GS 9 or 10 and seasonal problems = 1 Both SAD and S-SAD: SAD-win.: worst in Oct.–Mar. or SAD-sum.: worst in Apr.–Sept.	SAD-win.: 3.0% SAD-sum.: 0.1% S-SAD-win: 8.2% S-SAD-sum: 8.5% Mean GS: 4.8 (S.D. = 3.5) Changes with the seasons are a problem: 19.6%	226 respondents were interviewed with a structured DSM-III-R interview (the MDCL) Conclusion: SPAQ tends to underestimate prevalence rate (preliminary data)	No influence of month of completion on number of SAD cases. There was a significant difference between CES-Ds completed in summer and those completed in winter. The number of women with winter-SAD showed a peak at age 26–35.
Eagles et al. (1996)	UK: Aberdeen (57°N)	Dec.	Mail out; psychiatric nurses	—	443 (73%)	SPAQ	See 'Kasper criteria'	SAD: 2.9% S-SAD: 9.5% Adjusted for the population of Aberdeen: SAD: 1.9% S-SAD: 7.2%	—	Female/male ratio: 3:1 SAD most common in the 25–34 year age group.

Table 3
Overview of prevalence studies on SAD in other countries

Study	Location (latitude)	Month	Method/ sample	Selection criteria	No. of respondents (%)	Instruments	Criteria	Prevalence	Validation	Additional conclusions
Ito et al. (1992)	Quezon, The Philippines (15°N)	Jan./Feb.	Paper and pencil; employees of a department store	—	1053 (73.1%)	SPAQ	Both SAD and S-SAD not specified (probably 'Kasper criteria')	SAD-win.: 0% SAD-sum.: 0.1% S-SAD: 0% No distinction between winter and summer pattern on S-SAD Mean GS: 4.6 (S.D. = 4.0) Changes with the seasons are a problem: 10.8%	No	Authors conclude that seasonal mood changes seem to be related to hot/dry season rather than day length.
Madden et al. (1996)	Australia (10°S–40°S)	Nov.	Mail out	Twins	5661 (74.3%)	SPAQ	Not specified, probably 'Kasper criteria' (see Table 1)	SAD: 2.0% No distinction between winter and summer pattern on S-SAD Changes with the seasons are a problem: 13.0% Subjects feeling worst in winter: 17% Subjects feeling worst in summer: 8%	No	—
Morrissey et al. (1996)	Australia (19°S)	Sept.	Mail out	Random selection Age: > 18 years	176 (22%)	SPAQ	Kasper criteria (summer and winter type reversed)	SAD-sum.: 9.1% SAD-win.: 1.7% S-SAD-sum.: 16.4% S-SAD-win.: 1.1% Mean GS score: 7.3 (S.D. = 4.23) Changes with the seasons are a problem: 28.4%	No	Male:female ratio equal
Ozaki et al. (1995)	Nagoya Japan (35°N)	Dec.	Handed out Civil service employees at a work-related physical examination	No info	1276 (96%)	SPAQ	See Rosen et al. (1990) (see Table 1)	SAD-win.: 0.86% SAD-sum.: 0.94% S-SAD-win.: 0.86% S-SAD-sum.: 2.12%	No	No differences between male and female respondents in GS score.

the population this study is also left out of the analysis. Finally, the earlier discussed Italian study (Muscettola et al., 1995) is left out of the comparisons because of the extremely low response rate.

Also the survey methods differ. Most often (Terman, 1988; Rosen et al., 1990; Magnusson and Stefansson, 1993; Hagfors et al., 1995; Mersch et al., 1995; Muscettola et al., 1995) a questionnaire was mailed to the research population, while in some cases subjects were interviewed by telephone (Kasper et al., 1989a; Hagfors et al., 1992; Wirz-Justice et al., 1992; Levitt and Boyle, 1997). In one study (Booker and Hellekson, 1992) it is unclear whether subjects were interviewed at home or by telephone. Kasper et al. (1989a) preferred telephone interviews to mail out procedures because of the higher response rate. According to these authors the literature on survey methodology provides evidence that both methods are equally valid. Therefore, studies using either one of these survey methods will be included in the analysis.

Response rates may influence prevalence figures. For instants, it is possible that the probability of responding to the questionnaire may partly be a function of the presence of SAD symptoms. To test this an analysis of variance was performed on the selected studies showing no significant interaction ($F_{(1,10)} = 1.44$, $P = 0.58$). Also, there was no influence of latitude on response rate ($F_{(1,10)} = 1.43$, $P = 0.48$).

1.3. Prevalence and latitude

Correlations between prevalence and latitude (Spearman r_s; significancies are one-tailed) were calculated on North American (Terman, 1988; Kasper et al., 1989a; Rosen et al., 1990; Booker and Hellekson, 1992; Levitt and Boyle, 1997) and European studies (Hagfors et al., 1992, 1995; Wirz-Justice et al., 1992; Magnusson and Stefansson, 1993; Mersch et al., 1995). Some studies were performed over an area that included a range of latitudes (Hagfors et al., 1992, 1995; Wirz-Justice et al., 1992; Magnusson and Stefansson, 1993; Levitt and Boyle, 1997). The prevalence rates for these countries are averaged and plotted at the mean latitude. If available, figures for winter SAD were used. In studies that did not report separate values for winter and summer SAD (Booker and Hellekson, 1992; Hagfors et al., 1992, 1995; Wirz-Justice et al., 1992; Levitt and Boyle, 1997), the prevalence rates include both patterns. Because the rates for summer SAD are extremely low in the studies that did report these figures (see Tables 1–3), it is not likely that this procedure has influenced the results substantially. In Fig. 1 the prevalence rates are plotted as a function of latitude. The relationship is shown by linear curve-fits.

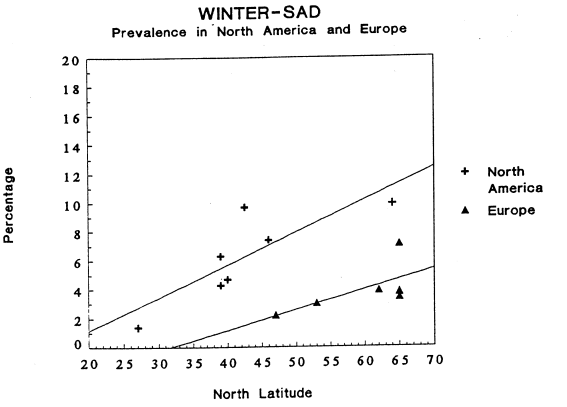

Fig. 1. Plots of the prevalence rates of winter SAD in the USA and Europe in relation to latitude. The straight lines are linear curve-fits.

The correlation shows a very weak insignificant positive relationship between prevalence and latitude: $r_{(n=13)} = 0.07$, $P = 0.415$. Visual inspection shows, however, that this low correlation can be explained for a large part by the difference between the North American and the European prevalence figures ($M_{NA} = 6.24$, S.D. = 3.06 and $M_{Eur} = 3.90$, S.D. = 1.69). This difference is significant as shown by an analysis of variance with latitude as covariate ($F_{(1,10)} = 20.33$, $P = 0.001$). Correlations between prevalence and latitude for the North American and European data, separately, are $r_{(n=7)} = 0.90$, $P = 0.003$ and $r_{(n=6)} = 0.70$, $P = 0.061$, respectively.

2. Discussion

The results of the correlation between latitude and prevalence are puzzling. The small overall correlation coefficient does not support the hypothesis of an

existing relationship between latitude and prevalence. The correlation coefficient for the North American studies, however, is highly significant, while the coefficient for the Europe studies shows a trend in the same direction. The conclusion is that if latitude influences prevalence, this influence is only weak. Apparently, other factors contribute considerably to the variance.

Climate may be one of these factors. Several studies, designed to examine the relationship between prevalence and latitude, failed to find an association (Partonen et al., 1993; Palinkas et al., 1996; Levitt and Boyle, 1997), while some of the studies that did find a positive correlation between prevalence and latitude also found a relationship with climatic variables. Potkin et al. (1986) reported highly negative correlations between prevalence and daylight hours and temperature and a highly positive correlation with cloudiness. The study in Japanese psychiatric clinics (Sakamoto et al., 1993) showed a weak relationship between prevalence and latitude, but a stronger negative correlation between prevalence and total hours of sunshine. In another study in Japan (Okawa et al., 1996) the global seasonality score also correlated with temperature and hours of sunshine.

Results from studies that were not designed to investigate the prevalence–latitude relationship also show the importance of climate. In the Philippines study (Ito et al., 1992) more subjects reported feeling worst in summer (7.7%) than in winter (4.2%), with the highest peak on the item 'feeling worst' in April. The authors concluded that mood changes and seasonal problems were more related to the hot-dry season than to the winter season. A comparable result was found in a prevalence study in Australia, in which Morrissey et al. (1996) found a high percentage of summer-SAD (9.1%) as opposed to winter-SAD (1.7%). A combination of heat and humidity apparently accounted for the high percentage of summer-SAD. In the study in Nagoya, Japan (Ozaki et al., 1995), the number of subjects with a summer pattern was 20% higher than the number of subjects with a winter pattern. Albert et al. (1991) concluded that eight out of 10 SAD patients were influenced by weather, while Molin et al. (1996) found significant correlations between mood and minutes of sunshine, global radiation, length of daylight and temperature in 126 SAD patients. If stressors play a role in the etiology of SAD, harsh climatological conditions may well be a trigger in subjects with a predisposition for SAD.

Climatological conditions may in part explain the large difference in prevalence between North America and Europe. The mean figure for North American studies, mainly performed in the USA, is twice as high as the mean figure for studies in Europe. On the basis of the latitude hypothesis, the opposite would be expected since the latitudes at which the studies were performed were higher in Europe than in North America ($M_{Eur} = 59.4°N$, S.D. = 7.6 versus $M_{NA} = 42.5°N$, S.D. = 11.1). The hypothesis that climate plays a dominant role, however, would qualitatively fit to the different rates between Europe and North America, because although located at the same latitude, the climate of New York is harsher than the climate in Madrid or Rome, while the climate is milder in Paris than in Newfoundland. Also, the presence of snow in the winter may influence prevalence rates by the increase of light reflected by the snow. Only one study investigated the influence of temperature on depressive symptoms by comparing 45 healthy subjects from the east coast of the USA with 42 healthy subjects from the west coast (Garvey et al., 1988). No differences were found on a depression scale (the BDI) or on questions concerning changes in sleep or appetite. The conclusion that climate does not play a role cannot be drawn, however, due to the small scale of the study and the sample selection (hospital staff and university employees).

Social and cultural factors may also play a role. Differences in cultural acceptance of admitting psychological problems may influence the answer to the question ''are seasonal changes a problem''. According to Hagfors et al. (1992), for instance, people in Finland are less inclined to answer this question in the affirmative since 'having a problem' is associated with alcohol abuse. Comparing their data with the Kasper et al. (1989a) study they found approximately equal GS score distributions, but much lower percentages on the 'problem' question (15.7% as compared to 27.0%) (Hagfors, 1993). Knowledge of SAD in the general population, which is likely to be greater in the USA than in Europe, may also influence ratings on the SPAQ and consequently

prevalence figures. In the Montgomery County study (Kasper et al., 1989a) the question whether respondents 'had heard of SAD' significantly contributed to the prediction of the difference between women with high and low seasonality scores.

Another factor that may be of influence on the differences in prevalence rates between different countries and/or cultures is the possible role of genetic factors in the etiology of SAD. In a study among Icelandic descendants in Canada (Magnusson and Axelsson, 1993), the low prevalence rate of winter SAD (1.2%) is more comparable with the prevalence rate in Iceland (3.8%) than with the rates in Nashua (9.7%) or Fairbanks, Alaska (9.9%). This result led the authors to suggest that genetic adaptation to high-latitude conditions may have taken place in the Icelandic population. Unfortunately, a control group of Canadians not descending from Iceland and living in the same area is lacking, so that the possible role of cultural development cannot be ruled out. Genetic differences in light tolerance are suggested (Hagfors et al., 1995) to explain the differences between the prevalence rate in Finland (7.1%) as opposed to the rates in Sweden (3.9%) and Iceland (3.8%). In an earlier study in Finland (Hagfors et al., 1992) a prevalence rate of 3.4% was found and there is no evidence that the difference between the higher figure in the 1995 study and the Swedish figure is more likely to be caused by genetic differences than by methodological artefacts or climatological or social–cultural factors.

Although a study by Allen et al. (1993) failed to find differences in family history between subjects with SAD and subjects with a nonseasonal mood disorder, two case-studies on children suggest a possible genetic component. In a study on seven children with SAD, Rosenthal et al. (1986) found that in five cases one of the parents suffered from SAD as well. Two children had a sister or brother with a diagnosis of SAD. In a study by Meesters (1995) two out of three children treated for SAD had a parent with a diagnosis of SAD. To conclude that a genetic factor explains these anecdotal data is speculative. An increased sensitivity of the parent with SAD to identical symptoms in the child may explain the high proportion of parents with SAD in these studies. Also, vicarious learning may take place in the upbringing of the child. More convincing are the results of a study by Madden et al. (1996) on monozygotic and dizygotic twins, suggesting that seasonality has a heritable component: 29% of the variance in seasonality (measured by the GS score) was explained by genetic influences in both men and women. This result was confirmed by a study by Jang et al. (1997a) among 187 monozygotic twins and 152 dizygotic twins. The GS score appeared to be significantly heritable among both males and females, explaining 69 and 45% of the variance, respectively.

That a relationship may play a role between psychological factors and SAD is shown by Murray et al. (1995), who found that neuroticism and locus of control were associated with seasonality and SAD. They suggested that ''SAD/seasonality might be more parsimoniously described as a manifestation of a generalised responsivity, rather than a discrete physiological vulnerability to variations in light'' (Murray et al., 1993a). Jang et al. (1997b) also found a relationship between seasonality in a sample of 297 adults drawn from the general population and neuroticism, measured by the NEO. Schuller et al. (1993) showed that SAD patients showed a different personality pattern than non-SAD major depressives. One study comparing remitted SAD patients with normal controls showed that the SAD patients were more neurotic than normals and showed a higher level of depressive and emotional reaction patterns to stress (Bouhuys et al., 1997). Therefore, more study on this subject seems worthwhile.

Finally, prevalence rates may be influenced by methodological aspects. In the first place several studies included in our analysis were reported as abstracts with few details on the applied methodology. Also, the prevalence of SAD in studies at the same location was different. The prevalence found in the Rosen et al. (1990) study in Montgomery County was almost 50% higher than the rate found in the Kasper et al. (1989a) study at the same location. In Finland, the prevalence rate in the Hagfors et al. (1995) study was more than 100% higher than in the Hagfors et al. (1992) study. Sampling and survey methodology apparently accounts for the differences in outcome.

Because of the widespread use of the SPAQ in prevalence studies, the validity of the instrument is important. Only a few external validity studies were

performed comparing the diagnosis based on the criteria of the SPAQ with a DSM interview by a clinician. One study showed that the SPAQ tends to be conservative and to underestimate the number of clinically assessed SAD subjects (Kasper et al., 1989a). In contrast, the result of a study by Magnusson (1996) showed that although the SPAQ overestimated the number of SAD subjects, the prevalence rate was similar to the rate after a clinical interview because the SPAQ missed SAD in subjects classified as S-SAD. In neither of the studies was the interviewer blind to the SPAQ diagnosis. A problem in the latter study was the 2-year time lapse between SPAQ screening and interview. Several longitudinal studies (Wicki et al., 1992; Leonhardt et al., 1994; Sakamoto et al., 1995; Schwartz et al., 1996; Thompson et al., 1995) have shown that between 59.8 and 74% of the patients with an initial diagnosis of SAD did not fulfil the criteria of this disorder several years later. Either SAD had fully remitted or the pattern of depressive episodes was no longer seasonal. These results suggest that the diagnosis of SAD is not very stable over time. This is also shown by two studies (Murray et al., 1993b; Wirz-Justice et al., 1993) that investigated the test–retest reliability of the diagnosis of SAD by means of the SPAQ. Of the subjects who met the SAD criteria at the first assessment, 41.4 and 50%, respectively, were not diagnosed as such at the second assessment. In the study by Levitt and Boyle (1997), the SPAQ detected four times as many SAD subjects (7.4 versus 1.7%) as a clinical interview based on the DSM-IV (American Psychiatric Association, 1994). That the SPAQ may overestimate the percentage SAD is also shown by a study by Blazer et al. (1994) in which 8098 subjects in the USA were interviewed to estimate the prevalence of major depression. The prevalence of a major depressive episode was 4.9%. Compared to this figure, the mean prevalence rate in North America of a comparatively rare affective disorder like SAD (6.2%) is clearly to high because it is contained in this 4.9%. Finally, the SPAQ may overestimate because of its retrospective nature. As Nayyar and Cochrane (1996) show, the SPAQ was much more pronounced in measuring retrospectively the difference in summer and winter mood than state measurement during the year (cf. Mersch et al., 1998).

3. Conclusions

The conclusion from the overview must be that the evidence for a positive correlation between prevalence and latitude is still unclear. It seems safe to conclude that if such a relationship exists, its impact on prevalence is smaller than (the combined effect of) a number of other factors of which climatological, social and cultural influences and genetic factors are most prominent. Or, as Rosen et al. (1990) concluded in the most supportive study for the latitude hypothesis: ‘‘ . . . only a small proportion of the variance is attributable to latitude’’ (p. 137). An interesting field of study would be to look more closely to the role of climate in the etiology of SAD. Some prevalence studies were designed to investigate the influence of latitude. In many studies, however, correlations were (also) found with a number of climatological conditions. Therefore, studies designed to investigate, at the same latitude, the influence of harsh winters/summers on prevalence rate as opposed to relatively mild winters/summers are of importance. A replication of the Garvey et al. (1988) study at a larger scale would be of interest. Also, cross-cultural studies would enable comparisons in social–cultural influences. This would include increased attention for psychological factors. Finally, the common use of the SPAQ as a screening instrument facilitates comparisons between studies. Nevertheless, it seems necessary to modify and improve the questionnaire to follow more closely the DSM-IV criteria of SAD and to improve its predictive power. This should be done by adding items about which there is agreement among researchers, so that the advantage of a widespread use of the same instrument is not lost. Examples are questions on the occurrence of depressive episodes in the last 2 years, the occurrence of non-seasonal episodes during the past 2 years and the occurrence of seasonally linked psychological stressors.

References

Albert, P.S., Rosen, L.N., Alexander, J.R., Rosenthal, N.E., 1991. Effect of daily variation in weather and sleep on Seasonal Affective Disorder. Psychiatry Res. 36, 51–63.

Allen, J.M., Lam, R.W., Remick, R.A., Sadovnick, A.D., 1993. Depressive symptoms and family history in seasonal and nonseasonal mood disorders. Am. J. Psychiatry 150, 443–448.

American Psychiatric Association, 1994. Diagnostic and Statistical Manual of Mental Disorders, 4th ed. American Psychiatric Association, Washington, DC.

Blazer, D.G., Kessler, R.C., McGonagle, K.A., Swartz, M.S., 1994. The prevalence and distribution of major depression in a national community sample: The National Comorbidity Survey. Am. J. Psychiatry 151, 979–986.

Booker, J.M., Hellekson, C.J., 1992. Prevalence of seasonal affective disorder in Alaska. Am. J. Psychiatry 149, 1176–1182.

Bouhuys, A.L., Meesters, Y., Jansen, J.H.C., Bloem, G.M., 1997. Personality in remitted seasonal affective disorder patients and its relevance to the onset of a next depressive episode: A prospective study. Submitted.

Carskadon, M.A., Acebo, C., 1993. Parental reports of seasonal mood and behavior changes in children. J. Am. Acad. Child Adolesc. Psychiatry 32, 264–269.

Eagles, J.M., Mercer, G., Boshier, A.J., Jamieson, F., 1996. Seasonal affective disorder among psychiatric nurses in Aberdeen. J. Affect. Disord. 37, 129–135.

Garvey, M.J., Goodes, M., Furlong, C., Tollefson, G.D., 1988. Does cold winter weather produce depressive symptoms? Int. J. Biometeorol. 32, 144–146.

Hagfors, C., 1993. 'Light sensitivity': real or expressiveness subscale on the SPAQ? Light Treat. Biol. Rhythms 6, 22–24.

Hagfors, C., Koskela, K., Tikkanen, J., 1992. Seasonal affective disorder (SAD) in Finland: an epidemiological study . Soc. Light Treat. Biol. Rhythms Abstract 4, 24.

Hagfors, C., Thorell, L.-H., Arned, M., 1995. Seasonality in Finland and Sweden, an epidemiologic study, preliminary results. Soc. Light Treat. Biol. Rhythms Abstract 7, 22.

Hardin, T.A., Wehr, T.A., Brewerton, T., Kasper, S., Berrettini, W., Rabkin, J., Rosenthal, N.E., 1991. Evaluation of seasonality in six clinical populations and two normal populations. J. Psychiat. Res. 25, 75–87.

Hedge, A.L., Woodson, H., 1996. Prevalence of seasonal changes in mood and behaviour during the winter months in central Texas. Psychiatry Res. 62, 265–271.

Ito, A., Ichihara, M., Hisanaga, N., Ono, Y., Kayukawa, Y., Ohta, T., Okada, T., Ozaki, N., 1992. Prevalence of seasonal mood changes in low latitude area: seasonal pattern assessment questionnaire score of Quezon city workers. Jpn. J. Psychiatry Neurol. 46, 249.

Jang, K.L., Lam, R.W., Livesley, W.J., Vernon, P.A., 1997. Gender differences in the heritability of seasonal mood change. Psychiatry Res. 70, 145–154.

Jang, K.L., Lam, R.W., Livesley, W.J., Vernon, P.A., 1997. The relationship between seasonal mood change and personality: more apparent then real? Acta Psychiatr. Scand. 95, 539–543.

Kasper, S., Rogers, S.L.B., Yancey, A., Schultz, P.M., Skwerer, R.G., Rosenthal, N.E., 1989. Phototherapy in individuals with and without subsyndromal seasonal affective disorder. Arch. Gen. Psychiatry 46, 837–844.

Kasper, S., Wehr, T.A., Bartko, J.J., Gaist, P.A., Rosenthal, N.E., 1989. Epidemiological changes in mood and behavior. A telephone survey of Montgomery County. Md Arch. Gen. Psychiatry 46, 823–833.

Leonhardt, G., Wirz-Justice, A., Kräuchi, K., Graw, P., Wunder, D., Haug, H.-J., 1994. Long-term follow-up of depression in seasonal affective disorder. Comp. Psychiatry 35, 457–464.

Levitt, A.J., Boyle, M.H., 1997. Latitude and the variation in seasonal depression and Seasonality of depressive symptoms. Soc. Light Treat. Biol. Rhythms Abstract 9, 14.

Lingjaerde, O., Bratlid, T., Hansen, T., Gotestam, K.G., 1986. Seasonal affective disorder and midwinter insomnia in the far north: studies on two related chronobiological disorders in Norway. Clin. Neuropharmacol. 9, 187–189.

Madden, P.A.F., Heath, A.C., Rosenthal, N.E., Martin, N.G., 1996. Seasonal changes in mood and behavior. The role of genetic factors. Arch. Gen. Psychiatry 53, 47–55.

Magnusson, A., 1996. Validation of the Seasonal Pattern Assessment Questionnaire (SPAQ). J. Affect. Disord. 40, 121–129.

Magnusson, A., Axelsson, J., 1993. The prevalence of seasonal affective disorder is low among descendants of Icelandic emigrants in Canada. Arch. Gen. Psychiatry 50, 947–951.

Magnusson, A., Stefansson, J., 1993. Prevalence of seasonal affective disorder in Iceland. Arch. Gen. Psychiatry 50, 941–946.

Meesters, Y., 1995. Lichttherapie bij drie kinderen met winterdepressie. Ned. Tijdschr. Geneeskd. 139, 2664–2666.

Mersch, P.P.A., Middendorp, H., Bouhuys, A.L., Beersma, D.G.M., Van den Hoofdakker, R.H., 1995. The prevalence of seasonal affective disorder (SAD) in The Netherlands. Acta Neuropsychiatr. 7, 47–49.

Mersch, P.P.A., Middendorp, H., Bouhuys, A.L., Beersma, D.G.M., Van den Hoofdakker, R.H., 1998. The prevalence of seasonal affective disorder in The Netherlands: a prospective and retrospective study of seasonal mood variation in the general population. Biological Psychiatry. In press.

Molin, J., Mellerup, E., Bolwig, P., Scheike, T., Dam, H., 1996. The influence of climate on development of winter depression. J. Affect. Disord. 37, 151–155.

Morrissey, S.A., Raggatt, P.T.F., James, B., Rogers, J., 1996. Seasonal affective disorder: some epidemiologic findings from a tropical climate. Aust. New Zealand J. Psychiatry 30, 579–586.

Murray, G., Armstrong, S., Hay, D., 1993. SPAQ reliability in an Australian twin sample. Light Treat. Biol. Rhythms 5, 32–33.

Murray, G., Armstrong, S., Hay, D., 1993. Seasonal affective variation in Australia: disorder or preference. Soc. Light Treat. Biol. Rhythms Abstract 5, 42.

Murray, G.W., Hay, D.A., Armstrong, S.M., 1995. Personality factors in seasonal affective disorder: Is seasonality an aspect of neuroticism? Person. Individ. Diff. 5, 613–617.

Muscettola, G., Barbato, G., Ficca, G., Beatrice, M., Puca, M., Aguglia, E., Amati, A., 1995. Seasonality of mood in Italy: role of latitude and sociocultural factors. J. Affect. Disord. 33, 135–139.

Nayyar, K., Cochrane, R., 1996. Seasonal changes in affective

state measured prospectively and retrospectively. British Journal of Psychiatry 168, 627–632.

Okawa, M., Shirakawa, S., Uchiyama, M., Oguri, M., Kohsaka, M., Mishima, K., Sakamoto, K., Inoue, H., Kamei, K., Takahashi, K., 1996. Seasonal variation of mood and behaviour in a healthy middle-aged population in Japan. Acta Psychiatr. Scand. 94, 211–216.

Ozaki, N., Ono, Y., Ito, A., Rosenthal, N.E., 1995. Prevalence of seasonal difficulties in mood and behavior among Japanese civil servants. Am. J. Psychiatry 152, 1225–1227.

Palinkas, L.A., Houseal, M., Rosenthal, N.E., 1996. Subsyndromal seasonal affective disorder in Antarctica. J. Nerv. Ment. Dis. 184, 530–534.

Partonen, T., Partinen, M., Lönnqvist, J., 1993. Frequencies of seasonal major depressive symptoms at high latitudes. Eur. Arch. Psychiatry Clin. Neurosci. 243, 189–192.

Potkin, S.G., Zetin, M., Stamenkovic, V., Kripke, D., Bunney, W.E., 1986. Seasonal affective disorder: prevalence varies with latitude climate. Clin. Neuropharmacol. 9, 181–183.

Rosen, L.N., Targum, S.D., Terman, M., Bryant, M.J., Hoffman, H., Kasper, S.F., Hamovit, J.R., Docherty, J.P., Welch, B., Rosenthal, N.E., 1990. Prevalence of seasonal affective disorder at four latitudes. Psychiatry Res. 31, 131–144.

Rosenthal, N.E., Sack, D.A., Gillin, J.C., Lewy, A.J., Goodwin, F.K., Davenport, Y., Mueller, P.S., Newsome, D.A., Wehr, T.A., 1984. Seasonal affective disorder. A description of the syndrome and preliminary findings with light therapy. Arch. Gen. Psychiatry 41, 72–80.

Rosenthal, N.E., Carpenter, C.J., James, S.P., Parry, B.L., Rogers, S.L.B., Wehr, T.A., 1986. Seasonal affective disorder in children and adolescents. Am. J. Psychiatry 143, 356–358.

Rosenthal, N.E., Genhart, M., Sack, D.A., Skwerer, R.G., Wehr, T.A., 1987. Seasonal affective disorder: relevance for treatment and research of bulimia. In: Hudson, J.L., Pope, H.G. (Eds.), Psychobiology of Bulimia. American Psychiatric Press, Washington, DC.

Sakamoto, K., Kamo, T., Nakadaira, S., Tamura, A., Takahashi, K., 1993. A nationwide survey of seasonal affective disorder at 53 outpatient university clinics in Japan. Acta Psychiatr. Scand. 83, 258–265.

Sakamoto, K., Nakadaira, S., Kamo, K., Kamo, T., Takahashi, K., 1995. A longitudinal follow-up study of seasonal affective disorder. Am. J. Psychiatry 152, 862–868.

Schuller, D.R., Bagby, R.M., Levitt, A.J., Joffe, R.T., 1993. A comparison of personality characteristics of seasonal and nonseasonal major depression. Comp. Psychiatry 34, 360–362.

Schwartz, P.J., Brown, C., Wehr, T.A., Rosenthal, N.E., 1996. Winter seasonal affective disorder: a follow-up study of the first 59 patients of the National Institute of Mental Health Seasonal Studies Program. Am. J. Psychiatry 153, 1028–1036.

Swedo, S.E., Pleeter, J.D., Richter, D.M., Hoffman, C.L., Allen, A.J., Hamburger, S.D., Turner, E.H., Yamada, E.M., Rosenthal, N.E., 1995. Rates of seasonal affective disorder in children and adolescents. Am. J. Psychiatry 152, 1016–1019.

Terman, M., 1988. On the question of mechanism in phototherapy for seasonal affective disorder: considerations of clinical efficacy and epidemiology. J. Biol. Rhythms 3, 155–172.

Thompson, C., Raheja, S.K., King, E.A., 1995. A follow-up study of seasonal affective disorder. Br. J. Psychiatry 167, 380–384.

Wicki, W., Angst, J., Merikangas, K.R., 1992. The Zurich Study: XIV. Epidemiology of seasonal depression. Eur. Arch. Psychiatry Clin. Neurosci. 241, 301–306.

Wirz-Justice, A., Kräuchi, K., Graw, P., Schulman, J., Wirz, H., 1992. Seasonality in Switzerland: An epidemiological survey. Soc. Light Treat. Biol. Rhythms Abstract 4, 33.

Wirz-Justice, A., Graw, P., Recker, S., 1993. The seasonal pattern assessment questionnaire (SPAQ): some comments. Light Treat. Biol. Rhythms 5, 31–32.