Associations between season of birth and suicide: a brief review

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Suicide is a complex behaviour contributing to a significant number of unnecessary deaths worldwide. Accordingly, the quest for suicide risk factors is one of the most intensively developing issues of psychiatric research. In the last few decades a number of interesting results have been published about associations between season of birth (SOB) and several physiological and pathological aspects of human life, while, in regard to neuroscience, several investigations confirmed that SOB is associated with the risk of several major neuropsychiatric disorders and suicide as well. Research concerning the possible causative factors behind these associations were also performed suggesting that SOB-associated factors (including day length; seasonal changes in maternal nutritional status and vitamin D levels; seasonal alterations in incidence of some common infective disorders) contribute to neurochemical and consequentially temperament/personality trait alterations which may mediate the associations between SOB and psychiatric disorders. Other results indicate an uneven distribution of monoamine metabolism-related genotypes in different birth season cohorts possibly underpinning the effects of SOB. In our narrative review we summarize and discuss the available literature on the relevance of the most important findings concerning the above fields.
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OVERVIEW OF SUICIDAL BEHAVIOUR AND ITS RISK FACTORS

Suicide is a major public health problem throughout the world. Accordingly, from a global perspective suicide is the tenth leading cause of death which means about one million suicide-related deaths/year worldwide (Hawton and van Heeringen, 2009; WHO). However, data must be interpreted with caution because of methodological difficulties by virtue of perpetual changes in data gathering of the WHO, in the last five decades worldwide suicide rates have increased by 60% and the proportion of young suicide victims has become even more pronounced (Hawton and van Heeringen, 2009; WHO; Bertolote and Fleischmann, 2002; Hoven et al., 2010). According to current estimates the annual global number of suicides will increase to 1.5 million by the year 2020 (Hoven et al., 2010). Suicide rates greatly vary among different countries and geographical areas of the world probably because of marked differences between these countries in regard to their social/ethnical/cultural background, quality of their mental health services and accuracy of their registration/classification systems for suicide cases (Hoven et al., 2010; Hawton and van Heeringen, 2009).

Suicide is a multicausal behaviour in which both environmental and genetic factors are known to be involved (Hawton and van Heeringen, 2009; Hawton and Saunders, 2009; Rihmer et al., 2002; Mann, 2003; Ernst et al., 2009), results, however, are not always unambiguous. A number of *psycho-socio-cultural and economic factors* (i.e. religiosity; marital status; peculiar personality characteristics and sexual orientations; physical abuse in childhood; working in some occupational categories; economic crises; income inequivality; employment status etc.) may influence the risk of suicidal behaviour. *Anthropometric/physiological variables* (i.e. body-mass index; height; respiratory functions; sleep duration; cholesterol level; ethnic belonging) may be also associated with suicidal behaviour (Hawton and van Heeringen,

2009; Mann, 2003; Gearing and Lizardi, 2009; Magnusson et al., 2005; Lundin and Hemmingsson, 2009; Lundin et al., 2010; Duleba et al., 2012; Chan et al., 2007; Brodsky and Stanley, 2008; Bartram and Baldwin, 2010; Troisi, 2009; Ernst et al., 2009; Giltay et al., 2010; Canoy et al., 2007; De Vogli and Gimeno, 2009; Chang et al., 2009; Chang et al., 2010; Zhang, 2011), and in addition, numerous *pathological conditions* (primarily psychiatric and substance use disorders including nicotine dependence, as well as potentially fatal somatic disorders and some kinds of respiratory disorders such as COPD and bronchial asthma) may also modify suicide risk (Hawton and van Heeringen, 2009; Hawton and Saunders, 2009; Mann, 2003; Goodwin and Marusic, 2008; Ernst et al., 2009; Giltay et al., 2010; Price et al., 2009; Harris and Barraclough, 1997; Schneider, 2009; Dome et al., 2010; Pridemore and Chamlin, 2006). The genetic determination of suicide (which only partially overlaps with the genetic determination of mood disorders) as well as the neurochemical correlates of suicidal behaviour are also strongly demonstrated (Mann, 2003; Ernst et al., 2009; Brezo et al., 2008; Carballo et al., 2008). Numerous *other factors* (i.e. spring-summer time; first days of the week; season of birth; changes in the psychiatric care system; antidepressant treatment; handgun ownership; high altitude of domicile etc.) may also influence the risk of suicidal behaviour (Rihmer et al., 2002; Hawton and Saunders, 2009; Dome et al., 2010; Woo et al., 2012; Zonda et al., 2008; Ohtsu et al., 2009; Kapusta et al., 2009; Sebestyen et al., 2010; Yoon and Bruckner, 2009; Miller and Hemenway, 2008; Wheeler et al., 2008; Fazel et al., 2011; Betz et al., 2011). It should be noted, however, that in spite of the numerous and diverse risk factors of suicide the role of DSM-IV Axis I mental illnesses as final common pathway is unquestionable. Accordingly, replicated studies confirmed that about 90% of suicide attempters and completers have at least one DSM-IV Axis I mental illness, most frequently mood disorders (Rihmer, 2007; Mann et al., 2005).

Many of the above suicide-risk influencing factors may be related to each other in different and complex ways (i.e. A→B [i.e. mental illness increases the risk to become unemployed; short sleep duration increases the risk of substance (ab)use; smoking leads to poor lung functions]; A→B+C [religiosity is associated with both decreased levels of aggression and substance use; poor childhood development provokes both decreased height and lung functions]; B+C→A [genetic predisposition and stressful life events together evoke mood disorder with a greater probability than either of them alone]; A↔B [i.e. pre-existing alcohol use disorder or major depression provoke the onset of major depression or alcohol use disorder, respectively]) (Lundin and Hemmingsson, 2009; Chan et al., 2007; Gearing and Lizardi, 2009; Giltay et al., 2010; Canoy et al., 2007; Mednick et al., 2010; Fergusson et al., 2009; Rutter, 2010; Liang and Chikritzhs, 2011; Lundin et al., 2010). Furthermore, additive interactions between some of these factors with respect to suicide risk are also described (e.g. the comorbidity of substance use disorders with mood disorders is associated with an additively elevated risk of suicide behaviour; depression is a farther risk factor for suicide in subjects with alcohol use disorder or schizophrenia) (Rihmer, 2007; Davis et al., 2008; McGirr et al., 2006; Reutfors et al., 2009; Swann, 2010; Pompili et al., 2007; Wasserman et al., 2012; Schneider, 2009; Hunt et al., 2006). Theoretically, it is also easy to imagine that some of the "well-known" suicide risk/protective factors are only in a non-causal relationship with the risk of suicide. For example let's assume that a hidden (i.e. unknown, unmeasured) factor determines both factor A and the risk of suicide in a similar manner, but factor A is causally unrelated to suicide. In this case the observable relationship between factor A and the risk of suicide is a "pseudo" one. Furthermore, there is another frustrating methodological issue that makes "true" suicide influencing factors more difficult to recognize: namely some studies on suicide risk factors are ecological ones consequently they may provide false positive results (for a recent paper on this topic see Betz et al., 2011). In summary, the very complex, multilevel relationship matrix of these and other non-detailed suicide-associated factors makes identification of "true" influencing factors of suicidal behaviour especially difficult (Mednick et al., 2010; Kendler, 2008; Nock, 2009; Nock et al., 2008).

For successful prediction and prevention it is essential to gain an in-depth knowledge concerning the etiological factors of suicidal behaviour. In this review, we discuss season of birth (SOB) as a possible risk factor of suicidal behaviour and also possible mediatory mechanisms in the background of the association between SOB and suicide.

RELEVANCE OF SEASON OF BIRTH (SOB) IN MEDICINE AND PSYCHIATRY

The ancient Greek physician Hippocrates in his book entitled "On Airs, Waters and Places" already stated that 'Whoever wishes to pursue the science of medicine in a direct manner must first investigate the sea-

sons of the year and what occurs in them' (Torrey et al., 2000). Since then a great number of investigations aimed at characterizing the exact link between SOB and physiological parameters or pathological states have been carried out.

Regarding normal (physiological) results of studies indicated that the variability in some human features (e.g. lifespan, handedness, chronotype) is influenced by SOB. Longevity (lifespan) has been consistently described in several samples from different countries to be associated with SOB, with those born during autumn/beginning of winter having the longest while those who born during spring/summer the shortest longevities (Doblhammer and Vaupel, 2001; Flouris et al., 2009; Vaiserman et al., 2002; Lerchl, 2004; Reffelmann et al., 2011; Gavrilov and Gavrilova, 2011). Results on the association between stature (height) and SOB are also consistent; those born in late spring/early summer are taller than those born in late autumn/early winter (Schwekendiek et al., 2009; Schwekendiek, 2009; Zhang, 2011). Some other investigated factors including handedness and chronotype show a less convincing association with SOB, but is should be note that the majority of studies found that the prevalence of the "evening type" is higher among those who born in spring/summer than among those who born in autumn/winter (Jones and Martin, 2008; Stoyanov et al., 2011; Tonetti et al., in press; Tonetti et al., 2011; Harada et al., 2011).

The association between SOB and risks of somatic disorders was also intensively investigated. There are mostly unambiguous findings in case of multiple sclerosis (risk is elevated among those who were born in spring/early summer) and celiac disease (risk is elevated among summer born individuals) (Fernandes de Abreu et al., 2009; Sotgiu et al., 2006; Willer et al., 2005; Bayes et al., 2010; Koch and Strobl, 2008; Templer et al., 1992; Pierrot-Deseilligny and Souberbielle, 2010; Gardener et al., 2009; Staples et al., 2010; Salzer et al., 2010; Disanto et al., 2012a; Ivarsson A, 2003; Lewy et al., 2009; Givon et al., 2012), while less consistent results are reported for narcolepsy, diabetes mellitus, Parkinson's disease, inflammatory bowel diseases (Crohn's disease and ulcerative colitis), allergic diseases and amyotrophic lateral sclerosis (Disanto et al., 2012b; Vassallo et al., 2010; Pyrhonen et al., 2012; Gazala et al., 2006; Kuzume and Kusu, 2007; Knudsen et al., 2007; Elliott et al., 2010; Kahn et al., 2009; Sonnenberg, 2009; Kohl et al., 2008; Gardener et al., 2010; Ajdacic-Gross et al., 1998; Fang et al., 2009; Koch and Raschka, 2007; Torrey et al., 2000; Postuma et al., 2007; Wing et al., 2008; Picchioni et al., 2007; Dauvilliers et al., 2003; Koepsell et al., 2010). In addition, several studies were pursued to reveal the effect of SOB on the risk of malignant disorders (i.e., brain tumors, testicular cancer, breast cancer, lymphomas, and leukemia; lung cancer), with similarly inconsistent resuls (Basta et al., 2010; Bernstein et al., 1986; Efird, 2010; Higgins et al., 2001; Hu et al., 1996; Prener and Carstensen, 1990; Staykov et al., 2009; Yuen et al., 1994; Kapitany et al., 2011).

The association between SOB and risks of several psychiatric disorders have also been repeatedly reported. Results are most consistent in regard to schizophrenia, with an excess of winter and early spring births among schizophrenic patients compared to the general population (interestingly, deficit schizophrenia characterized by marked negative symptoms but lower levels of suspiciousness, dysphoria, suicidality, comorbid substance use and hostility is associated with birth in summer) (Davies et al., 2003; Disanto et al., 2012b; Galderisi and Maj, 2009; Castrogiovanni et al., 1998; Brown and Patterson, 2011). At the same time, the association between schizotypy (as a type of personality in the continuum concept of schizophrenia characterized by similar cognitive, neurophysiological and neuroimaging changes to those observed in schizophrenia but symptoms of schizophrenia present only in a subclinical manner) and SOB has been less convincingly demonstrated (Hori et al., 2012). With respect to major depressive disorder (MDD) or depressive symptoms, results suggest that spring (/winter) birth is associated with a higher risk (Disanto et al., 2012b; Torrey et al., 1997; Joiner et al., 2002; Mino et al., 2000). Elevated risk for bipolar disorder is associated with winter-spring birth but negative results also exist (Castrogiovanni et al., 1998; Torrey et al., 1997; Disanto et al., 2012b; Mortensen et al., 2003; Tsuchiya et al., 2003). In regard to the effect of SOB on the risk of seasonal affective disorder results are ambiguous (Eagles et al., 2007; Pjrek et al., 2004). Findings on the association between SOB and the risk of anorexia nervosa are equivocal, but studies reporting a positive result suggest spring birth as a risk factor (Disanto et al., 2011; Vellisca et al., 2012; Winje et al., 2008). Data on the association between the risk of autistic spectrum disorders or ADHD and SOB are inconsistent (Hebert et al., 2010; Zerbo et al., 2011; Kowalyk et al., 2012).

It is less well-known that already from the 1960s a relatively few (n<15) studies investigated the association between the risk of suicidal behaviour and SOB. Some studies focused on suicide attempts (Rock et al., 2006; Beck and Lester, 1973; Riala et al., 2007) while

others on completed suicide (Rock et al., 2006; Dome et al., 2010; Pokorny, 1960; Lester et al., 1970; Lester, 1987; Sanborn and Sanborn, 1974; Neuner et al., 2010; Kettl et al., 1997; Salib and Cortina-Borja, 2010). Unfortunately, some of these studies have methodological problems including small sample sizes (sometimes the number of investigated suicide cases is less than 100), application of inappropriate statistical methods or lack of control group (see Salib and Cortina-Borja, 2010 for discussion). The results of these studies are not consistent, but the findings of studies with appropriate methodology suggest that spring/summer birth conveys a higher risk of completed suicide compared to birth in autumn/winter (Kettl et al., 1997; Salib and Cortina-Borja, 2010; Dome et al., 2010). The relative difference in the risk of completed suicide is approximately 15% between high-risk (spring/summer) and low-risk (autumn/winter) birth periods (Dome et al., 2010; Salib and Cortina-Borja, 2010).

In addition to psychiatric disorders and suicide, psychological phenomena including personality traits and temperaments have also been reported to be associated with birth season. The most consistently replicated result is the association of lower Novelty Seeking (NS) in winter born adult women compared to summer born adult women, while in adolescent girls there is an opposite pattern with higher NS scores in winter born subjects, which may, in addition to the association of this personality trait with SOB, also indicate an association between season of birth and pattern of personality development throughout the life span (Chotai et al., 2001; Chotai et al., 2009; Chotai et al., 2003a). Reward Dependence (RD) similarly showed an association with SOB but with somewhat mixed results; while in a Finnish study spring born men displayed significantly lower RD scores compared to autumn born men, a Swedish study reported significant results only for pooled genders with a peak in RD scores in December borns (Chotai et al., 2001; Chotai et al., 2009). In addition, personality traits in the Big 5 and Eysenck personality models have also been investigated. In a study applying the Neo-Pi-R, winter borns scored significantly lower on Agreeableness (Tochigi et al., 2004a), while another study reported significantly lower Conscientiousness scores in summer born males (Tonetti et al., 2009). Subjects born during cold months were reported to score higher on Extraversion (Forlano and Ehrlich, 1941; Chichilenko and Babarash, 2001), while conflicting results were reported for Neuroticism, with those born during cold moths scoring lower in one study (Forlano and Ehrlich, 1941), and summer borns scoring higher in another (Gupta, 1992), but a third study reported winter born young adults to score significantly higher on Neuroticism compared to those born during autumn (Chichilenko and Babarash, 2001). Our team has recently reported a significant association between affective temperaments and season of birth (Rihmer et al., 2011).

BRIEF SURVEY ON THE POSSIBLE EXPLANATIONS OF ASSOCIATIONS BETWEEN SOB AND PHYSIOLOGICAL/PATHOLOGICAL STATES

From a scientific point of view no one would seriously consider that associations reported between SOB and altered risks of the above discussed physiological and pathological parameters/states would be the consequence of a direct causative effect of SOB on these parameters/states. At the same time, there are a lot of theories aiming to explain these associations on the ground of science. In the followings, we will discuss some of those theories which were put forward to explain the association between SOB and certain psychiatric disorders (namely schizophrenia and depression). All these theories have in common that they suppose that SOB is only a proxy variable of "true" risk factors of psychiatric disorders/suicide. Accordingly, these theories imply that 1) the intensity of "true" risk factors shows a regular intra-annual cyclicity; 2) "true" risk factors exert their effects on neurochemical systems or genotypic distribution during the time of conception, gestation and/or in the peri-/postnatal period and ultimately these alterations cause neuropsychiatric disorders/suicide in a direct or in an indirect manner (through the influence of personality/temperament traits) in adulthood.

One of the most widely acknowledged "true" risk factor group which supposedly mediates the association between SOB and psychiatric disorders concerns infectious disorders during gestation. This hypothesis is highly plausible since it is known that some infective agents (e.g. influenza, rubella; Toxoplasma gondii, herpes simplex virus type 2) may cause congenital structural and functional brain abnormalities (Brown, 2011; Brown and Patterson, 2011; Khandaker et al., 2012). Furthermore, since the effect of SOB on the risk of schizophrenia is stronger in urban than in rural areas, the validity of this theory is even more probable (as it is known that infections spread more easily in urban areas) (Tochigi et al., 2004b). In addition, the incidence of infections with some common pathogens mentioned above, such as influenza and

rubella viruses show a marked intra-annual cyclicity (Tochigi et al., 2004b). Although several details of the theory remains unclear to date (for example which is the most sensitive period for vulnerability in regard to infections or whether there are common genetic roots of schizophrenia and susceptibility to infections), epidemiological investigations testing the hypothesis provided some evidence to support it (Brown, 2011; Brown and Patterson, 2011; Khandaker et al., 2012). Interestingly – in contrast to the case of schizophrenia – results concerning the effect of intrauterine infections on the risk of affective disorders are mainly negative (Selten and Morgan, 2010; Pang et al., 2009; Mortensen et al., 2011).

Prenatal nutritional factors are another attractive candidate to mediate the association between SOB and the risk of given psychiatric disorders. This seems reasonable, since levels of several nutrients may vary over the course of the calendar year and – as the results of the "famine studies" suggested – it is also known that deficient in utero nutrition may lead to elevated risk of schizophrenia (Brown, 2011; Lumey et al., 2011). Vitamin D was one of the nutritional factors under suspicion. Several facts underpin this theory: 1) vitamin-D levels in pregnant women vary through the calendar year (highest in autumn and their lowest in spring); 2) receptors for vitamin D are widely expressed in the brain 3) in utero vitamin-D deficiency leads to structural and functional brain abnormalities (some of them similar to those experienced in patients with schizophrenia); 4) dark-skinned subjects – whose vitamin-D synthesis is less sufficient – of migrant groups have an increased risk for psychotic disorders; 5) subjects born and grown up in urban areas (where elevated levels of ozone absorb great proportion of UVB which is necessary for the synthesis of vitamin-D in the skin) have a significantly higher risk for schizophrenia compared to those from rural areas; 6) schizophrenia is more frequent at higher latitudes; 7) results of birth-cohort and case-control studies also give some credence to this hypothesis (Brown, 2011; Pierrot-Deseilligny and Souberbielle, 2010; McGrath et al., 2011; McGrath et al., 2010; Amato et al., 2010; Holick, 1995).

Other theories are also exist on the possible mediators of associations between SOB and psychiatric disorders (e.g. high temperature at summer which may damage sperm cells; some kinds of pesticides with seasonally varying application in agriculture may cause neurodevelopmental abnormalities) but to date we have no sufficient empirical results on their validity (Tochigi et al., 2004b; Zerbo et al., 2011).

Previously we have mentioned that some seasonality-associated factors (e.g. in utero infections and vitamin-D deficiency) exert their effects directly on the central nervous system. For completeness, we should note that according to some results SOB is associated with indices of activity of the adult monoaminergic neurotransmitter systems. Although their results are somewhat conflicting in regard to the intra-annual pattern found, Chotai and Asberg (Chotai and Asberg, 1999) and Luykx et al. (Luykx et al., 2012) demonstrated that levels of the serotonin metabolite 5-HIAA in the CSF is a function of SOB (inconclusive results of these studies may emerge from the fact that one of them investigated subjects with mainly mood and anxiety disorders, while the other investigated healthy individuals). As disturbances of the serotonergic system are demonstrated both in affective disorders and in suicide victims we may presume that this finding may underpin the association between SOB and affective disorders/suicide (Mann, 2003; Cowen, 2008).

Another branch of studies supposed that distribution of genotypes of monoamine metabolism and transmission related and other candidate genes for psychiatric disorders may be uneven in case of different birth season cohorts. Accordingly, our workgroup recently demonstrated that the frequency of the 5-HTTLPR s varies according to season of birth (Gonda et al., 2012). As 5-HTTLPR is associated with the risk of affective disorders and suicidal behaviour our result may shed light on a novel mechanism behind the association of SOB and risk of depression/suicide (Gonda et al., 2012; Karg et al., 2011). Previously, Seeger et al. (2004) reported that the frequency of the seven-repeat allele of the 48bp VNTR polymorphism in the gene for dopamine D4 receptor differed between different birth season cohorts (Seeger et al., 2004). Chotai et al. (2003b) found that there is a significant association between SOB and the genotype in the A218C polymorphism of the tryptophan hydroxylase gene in a healthy female population (Chotai et al., 2003b; Lucock et al., 2010; Saetre et al., 2011; Rai, 2011; Peerbooms et al., 2012). How SOB influences genotype frequency in adult populations remains unanswered as yet, there are, however, several possible mechanisms proposed in the literature. It is one possibility that birth or rather conception cohorts do not show an uneven distribution of genotypes according to season, but certain genotypes are associated with critical seasons in certain pre-, peri- or antenatal periods with respect to chance of survival, suggesting the possible role of a selectional mechanism in the background of observed genotype frequency

unevenness (Gonda et al., 2012). Another possible explanation, the idiosyncratic conceptual patterns hypothesis postulates that certain genes give rise to such conditions or disorders, for example seasonal affective disorder, which may contribute to uneven frequency of procreating behaviour throughout the year, therefore parents carrying genes increasing susceptibility for these disorders will be less likely to be pass on their genetic material in certain conceiving season, contributing to unequal distribution of the genotypes in question in different birth seasons (Gonda et al., 2012).

POSSIBLE MEDIATING FACTORS AND MECHANISMS IN THE ASSOCIATION BETWEEN SUICIDE AND SEASON OF BIRTH

As discussed above, there are several factors associated with different types and aspects of suicidal behaviour which were shown to be associated with season of birth. Affective temperaments which have been reported by our team to show a complex and interesting relationship with birth season have been consistently reported to be risk factors of suicidal behaviours (Kochman et al., 2005). Affective temperaments carrying a depressive component (including depressive, cyclothymic, irritable and anxious temperaments) in general (Rihmer et al., 2009), and specifically a depressive-cyclothymic-anxious (Pompili et al., 2012; Pompili et al., 2008) constellation was identified as a suicide risk factor, while the hyperthymic temperament were reported to exert a protective effect (Vazquez et al., 2010). Similarly, the s allele of the 5-HTTLPR has been found to be associated with violent completed and attempted suicides in multiple studies (Gonda et al., 2011). The observed association between birth season and suicidal behaviour, and birth season and the relevant temperaments and genotypes factors show a remarkable coincidence according to studies (Gonda et al., 2012).

CONCLUSION

Chasing suicide risk factors is a complicated enterprise, since these phenomena present in a complex matrix of multilevel relationships. Furthermore, from the aspect of prediction and prevention, the causative chain of risk factors should be identified to be able to pinpoint those, which could be targeted in order to decrease chance of suicidality. In spite of this, as yet we do not have sufficient understanding concerning the etiopathology of human suicidality. Expanding results indicate the impact of birth season on suicidal behaviour with increasing supporting scientific evidence. This concept could provide a possible framework to define the place and role of various suicide risk factors identified so far. Further research is however warranted to understand it in its complexity and importance with respect to suicidal behaviour.

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A születési szezon és az öngyilkosság összefüggései: rövid összefoglaló tanulmány

Az öngyilkosság komplex viselkedésforma, amely világviszonylatban igen nagyszámú elkerülhető halálesethez vezet, ezért rizikófaktorainak vizsgálata a pszichiátriai kutatások egyik legintenzívebben művelt területévé vált. Az elmúlt évtizedekben számtalan eredmény született a születési szezon (SZSZ) és a legkülönfélébb élettani sajátosságok és patológiás állapotok közötti összefüggésekről. Az idegtudományok sem képeznek kivételt etekintetben, mivel több neuropszichiátriai kórkép kialakulásának kockázatát találták eltérőnek a különböző évszakokban született kohorszok között. Az összefüggések hátterében álló lehetséges mechanizmusok feltérképezése szintén megindult. Ennek kapcsán elmondható, hogy a SZSZ összefügg bizonyos tényezőkkel (napok hossza; az anya nutricionális állapotának és D-vitamin szintjének évszak szerinti változásai; egyes közönséges infektológiai kórképek incidenciájában jelentkező szezonális változások), melyek direkt módon befolyásolhatnak egyes neurokémiai paramétereket, illetve temperamentum/személyiség vonásokat, melyek aztán „közvetíthetik" a SZSZ és a pszichiátriai betegségek rizikója közötti kapcsolatot. Továbbá arra vonatkozó eredményekkel is rendelkezünk, hogy a naptári év eltérő időszakaiban született egyének genotípus gyakorisága bizonyos monoaminerg transzmissziót meghatározó gének tekintetében különböző, mely szintén magyarázhatja a fenti összefüggést. Áttekintő tanulmányunkban röviden összefoglaljuk a SZSZ és a pszichiátrai betegségek/öngyilkosság közötti kapcsolatról és annak lehetséges magyarázó mechanizmusairól elérhető releváns ismereteket.

Kulcsszavak: születési szezon; évszak; hónap; öngyilkosság; affektív temperamentum