REVIEW PAPER Curr Probl Psychiatry, Vol. 25(2024):92-100

DOI:10.12923/2353-8627/2024-0009

Czasopismo indeksowane na liście MNiSW - 70 pkt.

Risk factors of the depressive and anxiety disorders development among patients with Adolescent Idiopathic Scoliosis and possible therapeutic interventions

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Abstract

Introduction: Adolescent idiopathic scoliosis is a common type of scoliosis among adolescents. A significant problem is the coexistence of depressive and anxiety disorders. However, the causes of this condition are not fully recognized. Thus, it seems reasonable to search for possible risk factors that may trigger mental disorder occurrence.

Material and methods: This is a literature narrative review concentrating on the influence of the adolescent idiopathic scoliosis on the development of depression and anxiety disorders among adolescents, as well as possible therapeutic interventions. Google Scholar, Medline, PubMed and Science Direct databases were searched throughout January 2024 for relevant original and review articles from 2000 to 2024, using the following keywords: "adolescent idiopathic scoliosis", "anxiety", "body image", "bracing", "chronic disease", "depression", "mental disorders", "pain", "peer relationship", "physical activity", "pulmonary function", "sleep disorders", "surgery", "treatment". Manuscripts in other language than Polish or English were excluded from the search. To ensure the appropriate quality of this review, the Scale for the Assessment of Narrative Review Articles was used.

Results: Chronic pain, sleep disorders, pulmonary function impairment, perception of the disease as a chronic somatic disease, disturbed body image, lack of social interactions, physical activity limitation and applied methods of treatment may lead to the depressive and anxiety disorders development in the adolescent idiopathic scoliosis course.

Conclusions: Biological and psychosocial factors contribute to the pathogenesis of depressive and anxiety disorders among patients with adolescent idiopathic scoliosis. Their identification should help create a comprehensive plan of treatment, which may effectively maximize therapeutic outcomes in the context of both scoliosis and mental disorders.

Keywords: depression, risk factors, anxiety, adolescent idiopathic scoliosis, mental health

Streszczenie

Wstęp: Idiopatyczna skolioza młodzieńcza to często występujący typ skoliozy wśród adolescentów. Istotnym klinicznie problem jest współwystępowanie zarówno zaburzeń depresyjnych, jak i lękowych. Niemniej jednak, przyczyny tego stanu nie zostały do końca poznane. Zasadne wydaje się zatem, aby wyodrębnić czynnika ryzyka mogące przyczyniać się do wystąpienia tychże zaburzeń psychicznych.

Materiał i metody: Artykuł stanowi narracyjny przegląd literatury, koncentrujący się na możliwych czynnikach rozwoju zaburzeń depresyjnych i lękowych u pacjentów z idiopatyczną skoliozą młodzieńczą. Zaprezentowano ponadto możliwe działania profilaktyczno-terapeutyczne zapobiegające ich wystąpieniu oraz umożliwiające efektywne leczenie. Naukowe bazy danych, Google Scholar, Medline, PubMed i Science Direct, zostały przeszukane w styczniu 2024 pod kątem odpowiednich artykułów oryginalnych i poglądowych z lat 2000-2024, stosując następujące słowa kluczowe: „adolescent idiopathic scoliosis", „anxiety", „body image", „bracing", „chronic disease", „depression", „mental disorders", „pain", „peer relationship", „physical activity", „pulmonary function", „sleep disorders", „surgery", „treatment". Manuskrypty w języku innym niż polski lub angielski zostały wykluczone z przeglądu. Aby zapewnić odpowiednią jakość niniejszego artykułu, zastosowano wytyczne the Scale for the Assessment of Narrative Review Articles.

Dyskusja: Przewlekłe dolegliwości bólowe, zaburzenia snu, upośledzenie czynności płuc, a także postrzeganie skoliozy jako przewlekłej choroby somatycznej, zaburzony obraz własnego ciała, brak interakcji społecznych, ograniczenie aktywności

fizycznej oraz stosowane metody leczenia mogą prowadzić do rozwoju zaburzeń depresyjnych i lękowych w przebiegu idiopatycznej skoliozy młodzieńczej.

Wnioski: W patogenezie zaburzeń depresyjnych i lękowych u pacjentów cierpiących na idiopatyczną skoliozę młodzieńczą istotną rolę odgrywają zarówno czynniki biologiczne, jak i psychospołeczne. Ich identyfikacja powinna pomóc w stworzeniu kompleksowego planu leczenia, który może skutecznie zmaksymalizować efekty terapeutyczne zarówno w kontekście skoliozy, jak i zaburzeń psychicznych.

Słowa kluczowe: depresja, czynniki ryzyka, zaburzenia lękowe, zdrowie psychiczne, idiopatyczna skolioza młodzieńcza

Introduction

Adolescent idiopathic scoliosis (AIS), a three-dimensional and multifactor spinal deformity, is the most common type of scoliosis among the pediatric population and accounts for nearly 90% of all idiopathic scoliosis cases. It is diagnosed by confirmation of Cobb angle > 10^0 with accompanying vertebral rotation [1].

Epidemiological studies conducted so far indicate that the AIS may affect from 0.93% to 12% of subjects worldwide, depending on the region, ethnicity, genetic and environmental factors or healthcare system access [2]. Its prevalence and the tendency to progression of spinal curvature are higher among females [3]. Scoliosis, regardless of its etiology, is associated with numerous limitations and somatic comorbidities [4]. It is estimated that even 32% of subjects with AIS may feel psychological and emotional distress [5]. It has also been reported that subjects with an AIS diagnosis are more likely to suffer from various mental disorders, including depressive, anxiety or eating ones [6]. However, the exact incidence of anxiety and depressive disorders in this group of patients remains unknown in most countries and may vary from <5.0% to even >90.0%. [6,7]. These disparities may result from the lack of adequate epidemiological research, insufficient quality of already conducted studies or differences in the measurement tools used. Thus, it seems reliable to identify potential factors, which may have a significant impact on the development of these mental disorders, for better understanding of this phenomenon and taking appropriate preventive or therapeutic actions. This issue becomes even more important in the context of high rates of mental disorders incidence among adolescents worldwide, which may affect from 25.0 to 31.0% of subjects [8].

Aim of the study

In this review, we will attempt to show the specific role of particular biological and psychosocial factors in the development of depressive and anxiety disorders among patients with AIS. It will be accompanied by a consideration of the probable causes of the associations that occur. Moreover, possible therapeutic interventions that may reduce the risk of the mental disorders occurrence will be presented.

Material and methods

This article is a narrative review of the literature concentrating on the influence of the AIS on the development of depression and anxiety disorders among adolescents, as well as possible therapeutic interventions. Google Scholar, Medline, PubMed and Science Direct scientific databases were searched throughout January 2024 for relevant original and review articles from 2000 to 2024, using different combinations of the following keywords: “adolescent idiopathic scoliosis”, “anxiety”, “body image”, “bracing”, “chronic disease”, “depression”, “mental disorders”, “pain”, “peer relationship”, “physical activity”, “pulmonary function”, “sleep disorders”, “surgery”, “treatment”. Manuscripts in other language than Polish or English were excluded from the search. To ensure the appropriate quality of this review, the Scale for the Assessment of Narrative Review Articles (SANRA) was used [9].

Discussion

1. Biological factors

1.1. Chronic pain

In the course of scoliosis, the impairment of the biomechanical functions of the spine and paraspinal muscles is often observed [10,11]. This directly affects the promotion of inflammation within these tissues, and thus leads to a faster progression of degenerative changes, which, in turn, results in an increased risk of both acute and chronic pain [12,13]. Recent scientific evidence indicates that chronic back pain (CBP) is not a rare symptom reported in the adolescent group [14,15]. CBP is particularly more frequently observed among female adolescents, with spinal curvature assessed by a Cobb angle > 40 degrees, as well as in those who have been treated with non-surgical treatments for spinal curvature,

including bracing. In addition, the frequency of reported CBP increases with age [16].

The literature review provides evidence of frequent comorbidity of back pain and depression and anxiety disorders among subjects affected by AIS. Voepel-Lewis et al. revealed that a behavioral pain vulnerable profile of AIS subjects is associated with higher levels of depressiveness and fatigue, in comparison to the cluster of children with low pain symptoms [17]. Wong et al. confirmed these findings indicating that CBP acts as a risk factor for moderate depressive disorder development in the AIS population (OR, 2.49; p = 0.03; 95% CI, 1.08-5.71) [16]. This condition may be caused by functional, structural or neuroplastic changes in specific brain areas that are responsible for both the pain perception and the modulation of affect or mood: insular cortex, prefrontal cortex, anterior cingulate gyrus, thalamus, hippocampus and amygdala [18]. In addition, it has been also postulated that frequent comorbidity of chronic pain with affective or anxiety disorders may be partially caused by the phenomenon of impaired nociceptive modulation [19].

According to the position of the International Association for the Study of Pain, personal experience of pain is related not only to biological factors but also to psychological and social ones [20]. Therefore, the issue of pain catastrophizing, a particular cognitive style that is based on the pattern of negative thoughts and feelings associated with pain, may also play a significant role in the pain perception among adolescents with AIS [21]. Patients have a particular tendency to ruminate about pain, focusing on the worst possible effects, and exaggerating it [22]. In the Ramo et al. study, it was revealed that among 189 patients undergoing posterior spinal fusion due to AIS, 10.6% of them presented pain catastrophizing pattern[23]. On the other hand, as Mikkelsen et al. pointed out, among adolescents experiencing chronic pain, worse self-esteem, self-efficacy and increased feeling of loneliness are significantly more often observed. In this context, it is emphasized that proper self-related personality traits (e.g. self-esteem, self-control) or strong social interactions act as resilience factors and are crucial for ensuring the psychological well-being of adolescents, as well as protecting from the depressive disorders development [24,25].

To sum up, it is essential to ensure proper pain management among subjects with AIS. It becomes even more important in the context of the bidirectional relationship between pain and affective disorders: chronic pain predisposes to the development of depressive and anxiety disorders, but also, in the course of these mental disorders, an increase in complaints associated with chronic pain syndromes is observed [26,27]. Thus, regular monitoring of pain symptoms severity and taking appropriate pain-relief actions, according to the World Health Organization analgesic ladder, should come in useful [28]. At the same time, special care should be taken in the context of possible side effects of applied painkillers (e.g. peptic ulcer disease after non-steroidal anti-inflammatory drugs or the risk of addiction in case of the opioids use) [29,30]. Moreover, the use of particular psychotropic medications, which, in addition to their anxiolytic and antidepressant properties, act as coanalgesics, is also reliable in this condition (Table 1.). However, it is worth noting that their use is off-label in most of cases among children and adolescents. It may be also associated with numerous side effects [34,35]. Therefore, they should be prescribed with great caution. Psychotherapeutic interventions, especially Cognitive Behavioral Therapy for Chronic Pain (CBT-CP), seem to play a supportive role [36].

Table 1. Chosen agents in the treatment of depressive and/or anxiety disorders with concomitant chronic pain symptoms.

The name of the psychotropic drug	The group of the drug	Initial dose [mg/day]	Maximum daily dosage [mg/day]	References
amitriptyline	TCA	10	150	[31]
imipramine	TCA	10	150	[32]
duloxetine	SNRI	30	60	[32]
milnacipran	SNRI	12.5	100	[33]
venlafaxine	SNRI	37.5	225	[32]

Abbreviations: serotonin and norepinephrine reuptake inhibitor, SNRI; tricyclic antidepressant, TCA.

1.2. Sleep disorders

Adequate sleep quality, quantity and architecture are important factors in ensuring complete individual mental health and proper psychosocial functioning [37]. It has been already pointed out that sleep disturbances may disrupt the proper functioning of the amygdala, which is responsible for regulating emotional processes [38]. Moreover, the role of sleep during adolescence period in the refinement of neural connectivity in the prefrontal cortex, underpinning decision-making, reward processing, social interactions and emotion, is emphasized [39]. In addition, irregular sleep patterns among adolescents may affect the volume of the hippocampus grey matter, whose dysfunction is associated with several neuropsychiatric conditions [40]. Therefore, sleep disorders (SD) are not

without significance in the context of the development of depressive and anxiety disorders, although, the bidirectional relationship between these two states is observed in this context: both of them may trigger each other with subsequent co-occurrence [41].

SD appear to be a common problem among adolescents affected by AIS, however so far, there have been only a few studies examining this issue. Wong et al. indicated that the most frequently observed disorders are insomnia and excessive daytime sleepiness [16]. In the Yakut et al. study, in accordance with previous research, 68.4% of subjects with AIS declared poor sleep quality. In addition, an association between deteriorated sleep quality and a higher incidence of depressive disorders, increased sensitization to pain stimuli and greater severity of pain, was observed [19,40]. At the core of sleep disorders among adolescents with AIS may lie episodes of apnea and hypopnea during sleep (described below), chronic pain, physical disability or psychological distress [40].

Thus, taking into account the abovementioned findings, modifiable risk factors for sleep disorders should be actively sought among children and adolescents with AIS. Proper sleep hygiene may prevent them, at least partially, from mental disorders development. In addition, behavioral interventions and possible pharmacological treatment of sleep disorders may also play a supportive role.

1.3. Pulmonary function impairment

Respiratory disorders are often observed in the course of scoliosis. Chest wall deformations, causing a decrease in lung volume, lead to restrictive lung disease [42]. On the other hand, the issue of airway obstruction among patients with AIS was also emphasized in several studies [43,44]. These conditions may result in dyspnea, which was pointed out as a strong predictive factor for depression and anxiety disorders development in the course of chronic lung disorders [45]. Moreover, the issue of insufficient ventilation during sleep in the course of scoliosis was also found. Li et al. showed that subjects with scoliosis, including AIS, are more likely to have episodes of apnea and hypopnea during sleep, compared to the control group [46]. The aforementioned apnea episodes have been shown to be a predisposing factor for the development of depression [47]. Recurrent transient hypoxia with subsequent reoxygenation may lead to ischemic reperfusion and neuroinflammatory injuries within the hippocampus, whose dysfunction may result in mood disorders development [38,48]. The issue of disturbed gene expression for the Brain-Derived Neurotrophic Factor (BDNF) under the influence of hypoxia episodes is also emphasized. This molecule is responsible for the neuronal growth and the neuroplasticity of the brain – its reduced concentration is observed in both patients with episodes of sleep apnea and depression [49,50].

From this perspective, particular actions, including conservative and surgical treatment, should be taken to stop the progression or to reduce the degree of spinal curvature, which directly affects the severity of pulmonary complications among subjects with AIS [51]. It is also important to pay attention when prescribing benzodiazepines, as a supportive form of treatment in depressive-anxiety disorders, due to the risk of respiratory depression.

2. Psychosocial factors

2.1. AIS as a chronic somatic disease

According to the Transactional Model of Stress and Coping, proposed by Lazarus and Folkman, the diagnosis of a chronic disease can be perceived as a stressor, the severity and consequences of which depend on the individual cognitive assessment and coping mechanisms activation. After confronting with the stressors, the individual evaluates their importance (primary appraisal) and their own resources to overcome it (secondary appraisal). Primary and secondary appraisals are believed to have an influence on coping strategies choices. Coping mechanisms affect immediate stress response, as well as long-term consequences, including psychological well-being and social functioning [52]. However, in the period of adolescence, when appropriate cognitive perception and coping strategies are formed, the stressful situation may exceed the adaptive resources of the adolescent and promote the occurrence of mental disorders [53].

On the other hand, Orzechowska et al. reported that patients suffering from chronic somatic symptom disorders may have higher emotional and rational motivation, lower emotional resilience and lower emotional arousal. It may result in emotional dysregulation and alexithymia, leading to poorly controlled responses to negative stimuli [54]. This issue, in turn, may make these subjects more sensitive to the development of various mental disorders, including depressive and anxiety ones [55,56]. Moreover, adolescence itself is a crucial time when a lot of new challenges and difficulties on many levels of individual functioning appear. Usually, they are often accompanied by changes in emotional states and loss of control over emotions. Thus, it may also contribute to psychological distress and emotional instability, which may worsen the adolescent's reaction or approach to AIS diagnosis [57].

All in all, taking into account the age of the onset of AIS and its chronic course, incorrectly developing cognitive and emotional schemas may play a significant role in the development of depressive and anxiety disorders.

In addition, their consolidation in adulthood may lead to the development of abnormal personality traits, as well as frequent relapses of accompanying mental disorders. Thus, early psychotherapeutic interventions are required to prevent adolescents from the abovementioned consequences.

2.2. Body image

Body image is perceived as a complex psychological construct referring to the perception, thoughts, feelings, evaluations and behaviors related to one's body [58]. The evidence collected so far is sufficient to consider body image as an essential factor in the psychological well-being of adolescents [59]. Its significance is associated with self-esteem, emotional competence or social functioning, especially in the turbulent period of adolescence [58].

In the physical examination, patients affected by AIS usually have back or chest deformity, asymmetry of the shoulder and waist levels, as well as prominent ribs. Therefore, these pathological changes in posture may act as a trigger for appearance concerns and body dissatisfaction. A qualitative review of already conducted on this topic studies, performed by Bertuccelli et al., confirmed that body image alternation is a serious clinical problem among adolescents with AIS, especially highly prevalent in more severe scoliosis cases [60]. Korovessis et al. made also a point that disturbances in the perception of own's body increase while getting older [61]. In the context of mental disorders occurrence, numerous studies revealed that AIS patients with larger Cobb angle are more prone to depressive disorders development than those with less severe deformities [62–64]. Auerbach et al. also indicated that appearance concerns were positively correlated with the mental subdomain of the Scoliosis Research Society-22 questionnaire, as well as there was a trend toward a significant correlation with the anhedonia subdomain of the Children's Depression Index [65].

In the light of abovementioned findings, it is essential to search for the appropriate approach that may result in body satisfaction improvement. As it was noted in several research, surgery seems to be the only intervention that may improve body image outcomes [66,67]. Nevertheless, taking into account the multimodal nature of body image, further studies in this field are required to explore deeply this issue.

2.3. Relationships with peers

During adolescence, there is a strong need of belonging to a given social group, being accepted by peers or receiving help and support from them [68]. It is emphasized that such factors ensure proper mental health well-being among young subjects [69]. It has been also shown that the quality of peer relationships in the period of adolescence is a strong predictor of the depressive and anxiety symptoms severity [68,70].

D'Agata et al. observed that adolescents with idiopathic scoliosis present a specific style of personality, based on the social inhibition (introversion), the preference for staying alone and being self-sufficient [71]. Thus, these personality traits may hinder the socializing process with peers. In addition, some of them may avoid leaving the house and engaging in social interactions because of the feeling of shame and alienation from their peers due to applied methods of treatment like bracing [72]. Similarly, Głowacki et al. observed that patients with scoliosis experienced symptoms of social anxiety as a result of teasing from peers due to bracing [73]. Relatively frequent hospitalizations, periods of convalescence after surgical procedures, stays in full-day rehabilitation centers and the related absences from school may also deepen the social distance between adolescents with AIS and their peers.

In the light of these evidences, parents, teachers and medical professionals should pay particular attention to the issue of social isolation among adolescents with AIS and any case of bullying from peers, to ensure proper psychological support. Social skills training (SST) may be beneficial for those subjects who have problems in establishing or maintaining social contacts. Support groups run by professionals could be helpful, where young patients would share daily difficulties associated with the disease and its treatment, thus eliminating feelings of isolation and alienation. Moreover, a decision for bracing treatment inclusion, perceived as one of the most important triggers limiting self-confidence among subjects with idiopathic scoliosis, should result from a positive balance of therapeutic benefits and losses.

2.4. Physical activity limitation

Several studies indicated that patients with AIS have significantly lower rates of physical activity (PA) compared to their healthy peers. Moreover, most of them do not even meet the bare minimum of PA recommended by the World Health Organization [74,75]. This state may be caused by various factors that occur (Table 2.).

It is postulated that the lack or insufficient amount of PA may play a role as a risk factor for depression and anxiety disorders occurrence among adolescents [76,77]. In addition, Schuch et al. in their meta-analysis indicated that exercising has a significant antidepressant effect on subjects diagnosed with Major Depressive Disorder [78]. Similar findings were found regarding the anxiety disorder symptoms reduction [79]. It is emphasized that PA can reduce the severity of mental disorders symptoms mainly through improving self-esteem, self-concept, and self-efficacy [80].

Table 2. Factors limiting physical activity among children and adolescents with AIS.

the severity of structural deformity, the range of motion limitation
the presence of pain symptoms
kinesiophobia
algophobia, pain catastrophizing
treatment methods used (bracing, surgery)
lack of independence: the dependence on the help of third parties in daily self-care activities
feeling of loneliness, lack of belonging to a peer group

Thus, it seems important to ensure an appropriate level of physical activity for adolescents with AIS. Various exercises, including conservative forms of scoliosis treatment like Physiotherapeutic Scoliosis-Specific Exercise (PSSE) methods or core stabilization exercises, are found to be generally safe for subjects with AIS. Moreover, they may deliver overall health benefits and those related to the mental health as well [81–84]. Other forms of PA should be considered individually with physiotherapists and orthopedists, depending on the clinical case. We should not also forget about appropriate psychotherapeutic interventions aimed at dealing with kinesiophobia or algophobia, which may limit daily activities and engaging in various other forms of PA (swimming, jogging, etc.).

2.5. Applied methods of the treatment

As it was mentioned previously, orthopedic bracing may significantly impair the psychosocial functioning of adolescents by disrupting body image, limiting PA or worsening interpersonal relationships with peers, which, in turn, may trigger or aggravate the anxiety and depressive symptoms [72,85,86].

On the other hand, surgery also seems to be a potential stressor that may disturb mental health well-being. Patients facing planned surgery have to change their lifestyle, adapt existing duties to the date of surgery, hospital stay and long convalescence. In addition, the vision of the possible surgery complications, prolonged recovery or long-lasting disability may lead to psychological distress among patients before the surgery [87]. In the postoperative period, pain symptoms, delayed wound healing, wound infection or limited mobility may also significantly impair psychological well-being [88]. Feeling of loneliness, isolation from peers and dependence on the help of third parties in daily self-care activities during the recovery may worsen this state. Despite these difficulties that adolescents with AIS have to face in both pre-and postoperative periods of time, surgical correction of deformities can bring significant improvements in the Quality of Life (QoL) and mental state of patients in the long-term perspective [89]. Nevertheless, proper psychological interventions in the perioperative time may be valuable in reducing the level of stress, anxiety, or even depressive symptoms.

Conclusions

In this review, we presented the multifactorial nature of depressive and anxiety disorders among adolescents with AIS. Both biological and psychosocial factors play a role in the pathogenesis of these conditions. Not only chronic pain symptoms, sleep disorders or pulmonary function impairment, but also the issue of chronic disease, disturbed body image or schema, lack of relationships with peers or applied methods of treatment may trigger mental disorders occurrence. Hence, the identification of these risk factors should help create a comprehensive plan of treatment, which may effectively maximize therapeutic outcomes in the context of both scoliosis and mental disorders.

Conflict of interest

The authors have declared no conflict of interest.

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Otrzymano: 15.03.2024
Zrecenzowano: 02.05.2024
Przyjęto do publikacji: 11.06.2024