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Is There an Association Between Psychiatric Disorders and Adolescent Idiopathic Scoliosis? A Large-database Study

Soo-Bin Lee MD[1,2], Hyun-Wook Chae MD[3], Ji-Won Kwon MD[1,4], Sahyun Sung MD[5], Hwan-Mo Lee MD, PhD[1], Seong-Hwan Moon MD, PhD[1], Byung Ho Lee MD, PhD[1]

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Abstract

Background Children with adolescent idiopathic scoliosis (AIS) have reduced quality of life related to poor self-image, perhaps because of cosmetic concerns. However, there has not been a large-database epidemiologic study on the association between psychiatric disorders and scoliosis.

Questions/purposes Using the Korean National Health Insurance database, we asked: (1) How common are psychiatric disorders among children with AIS? (2) After controlling for gender, age, insurance type, and residential district, are psychiatric disorders more common among children with AIS than among age-matched controls?

Methods A retrospective analysis was conducted using sample datasets from the Health Insurance Review and Assessment Service from 2012 to 2016, which is a 10% randomly extracted sample of total inpatients and outpatients each year. The mean number of total patients in each dataset was 1,047,603 ± 34,534. The mean number of children with AIS was 7409 ± 158 for each year. The age criteria was 10 to 19 years for the matching. Mood disorders, anxiety disorders, and behavioral disorders were selected as disorders possibly associated with AIS. We identified children with AIS who had any of the disorders above, and we obtained the prevalence of these disorders based on diagnostic codes. As an exploratory analysis, clinically meaningful variables were selected among the available codes in the dataset, and a univariable logistic regression test was performed for each variable. A multivariable logistic regression test with advanced variables was performed to identify the adjusted odds ratios of psychiatric disorders in children with AIS.

Results The median (range) prevalence of psychiatric disorders in children with AIS from 2012 to 2016 was 7% (6% to 7%). Compared with children who did not have AIS, and after controlling for gender, age, insurance type, and residential district, children with AIS

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Ethical approval for this study was obtained from the institutional review board of Yonsei University, Gangnam Severance Hospital, Seoul, Korea (IRB# 3-2018-0041).
This study was performed at Yonsei University College of Medicine, Seoul, Republic of Korea.

[1]Department of Orthopedic Surgery, Yonsei University College of Medicine, Seoul, Republic of Korea

[2]Department of Orthopedic Surgery, Bundang Jesaeng Hospital, Gyeonggi-do, Republic of Korea

[3]Department of Pediatrics, Yonsei University College of Medicine, Seoul, Republic of Korea

[4]Department of Orthopedic Surgery, National Health Insurance Service Ilsan Hospital, Gyeonggi-do, Republic of Korea

[5]Department of Orthopedic Surgery, Ewha Woman's University Seoul Hospital, Seoul, Republic of Korea

B. H. Lee ✉, Department of Orthopedic Surgery, Yonsei University College of Medicine, 50-1 Yonsei-ro, Seodaemun-gu, Seoul, 03722, Republic of Korea, Email: bhlee96@yuhs.ac

were more likely to have psychiatric disorders in all 5 years. The adjusted ORs of psychiatric disorders in children with AIS compared with children who did not have AIS ranged from 1.47 to 1.74 (2012: OR 1.60 [95% CI 1.46 to 1.75]; p < 0.001; 2013: OR 1.73 [95% CI 1.58 to 1.89]; p < 0.001; 2014: OR 1.74 [95% CI 1.59 to 1.91]; p < 0.001; 2015: OR 1.71 [95% CI 1.56 to 1.88]; p < 0.001; 2016: OR 1.47 [95% CI 1.33 to 1.62]; p < 0.001).
Conclusion Considering the higher prevalence of psychiatric disorders in children with AIS compared with children who did not have AIS, children with AIS and their parents should be counseled about the increased risk of deteriorating mental health of the patients, and surgeons should provide early referral to pediatric psychiatrists. Further studies should investigate the effect of the factors related to AIS, such as curve type, Cobb angle, and treatment modality.
Level of Evidence Level III, prognostic study.

Introduction

Adolescent idiopathic scoliosis (AIS) is a spinal deformity that occurs without a known cause in children aged between 10 and 19 years [13]. Most AIS patients present no specific symptoms except the trunk deformity, although back pain or cardiopulmonary problems appear in some patients [35]. In general, bracing for a long period is indicated for intermediate curves, and surgery is indicated for curves of 50° or more [36]. In 2011, the mean hospital cost for AIS surgery in the United States was USD 155,278, and the cost has been increasing annually [20]. Meanwhile, psychiatric disorders in children have deleterious consequences on individual and socioeconomic factors. Psychiatric disorders can impede healthful transitioning into adulthood, and the incidence of psychiatric disorders has been increasing over decades [37]. Numerous studies have reported an association between psychiatric disorders and various medical conditions as risk factors, such as somatic comorbidity, intellectual disability, and burn [1, 16, 32]. Similarly, AIS has also been suggested as a negative factor for mental health in several studies [7, 21, 24, 29, 33]. A review on AIS indicated that psychologic comorbidities were correlated with subjective body image and a higher risk of mood disorders [11].

However, to our knowledge, there has not been a large-database epidemiologic study on the association between psychiatric disorders and AIS in children. Most previous studies on mental health in children with AIS mainly used questionnaire methods and included small samples [7, 11, 21, 24, 29, 33]. Furthermore, most studies were confined to the psychosocial effect of treatment modalities, including brace and surgery [21, 29, 41]. In this study, we wanted to evaluate the prevalence of psychiatric disorders among children with AIS and the relationship between AIS and psychiatric disorders.

Using the Korean National Health Insurance database, we therefore asked: (1) How common are psychiatric disorders among children with AIS? (2) After controlling for gender, age, insurance type, and residential district, are psychiatric disorders more common among children with AIS than among age-matched controls?

Patients and Methods

This study was based on the Health Insurance Review and Assessment Service patient sample data (HIRA-PPS-2012-0077, 2013-0082, 2014-0078, 2015-0086, and 2016-0061), and the obtained results were independent from the Health Insurance Review and Assessment Service and the Ministry of Health and Welfare of Korea.

Data Source

All medical institutions in Korea are designated National Health Insurance institutions, and they perform all processes of medical claims on behalf of the patients. For all citizens, the Korean National Health Insurance system allows free access to services by medical institutions without undergoing cumbersome claims procedures. The Health Insurance Review and Assessment Service is an assessment institution that evaluates the adequacy of medical services and fees whenever claims are submitted. In this context, the combined functions of medical institutes and Health Insurance Review and Assessment Service allow the Korean government to access all information about the medical procedures of citizens. The Health Insurance Review and Assessment Service collects each patient's data, such as diagnoses, treatments, and prescriptions, and reports them by anonymization through the replacement of personal identifiers with surrogate numbers. In this manner, statistically sampled datasets of children are available for analysis each year. Vast amounts of national patient information are stored in computerized files, making it suitable for identifying information that is difficult to find in small-scale research; and for this reason, we chose these particular data in this study. The dataset is a randomly extracted statistical sample among a total of approximately 10 million children who visited a medical institution at least once a year, with an extraction rate of 10%. The insurance type consisted of national health insurance and medical aid. National health insurance covers 96% of the Korean population, and the remaining 4% are covered by medical aid, which is a social policy

for the poor. The medical institution region was divided into three groups (metropolitan, city, and rural), and the patient's residence was deduced from these data. If there were multiple medical institution region codes, the most frequently entered code for the outer area was selected for the residence, considering the healthcare delivery system direction, from rural to metropolitan.

Patients

Datasets from 2012 to 2016 were included in this study. The mean number of patients in the dataset was 1,047,603 ± 34,534. The inclusion criteria for children with AIS were ages and diagnostic codes. The age criteria were 10 to 19 years, and the following diagnostic codes were used, as defined by the ICD-10: M41.2 (other idiopathic scoliosis), M41.3 (thoracogenic scoliosis), M41.8 (other forms of scoliosis), and M41.9 (scoliosis, unspecified). Diagnostic codes for other scoliosis type, including M41.0 (infantile idiopathic scoliosis), M41.1 (juvenile idiopathic scoliosis), M41.4 (neuromuscular scoliosis), M41.5 (other secondary scoliosis), and Q76.3-4 (congenital scoliosis), were excluded. The mean number of children with AIS was 7409 ± 158. The control group was defined as children in the dataset who did not have any of the above diagnostic codes, and they were age-matched with the children with AIS. The mean number of patients in the control group was 582,617 ± 30,683. Psychiatric disorders with a possible association with AIS (mood disorders, anxiety disorders, and behavioral disorders) were selected by a pediatrician (HWC) and an orthopaedic surgeon (BHL) with more than 10 years of experience in their specialty. Major disorders of each category in our study included: depression, bipolar disorder, and dysthymia for mood disorders; panic disorder, neurosis, and somatoform disorder for anxiety disorders; anorexia nervosa, sleep disorder, and elective mutism for behavioral disorders. The ICD-10 diagnostic codes for these three groups were F3 (mood disorders), F4 (neurotic, stress-related, and somatoform disorders), F5 (behavioral syndromes associated with physiologic disturbances and physical factors), and F9 (behavioral and emotional disorders with onset usually occurring in childhood and adolescence).

Primary and Secondary Study Outcomes

Our primary study goal was to verify how common psychiatric disorders are among children with AIS. To achieve this, we calculated the patient numbers based on diagnostic codes. The proportion of children with AIS who had psychiatric disorders were obtained for all 5 years.

Our secondary study goal was to verify whether psychiatric disorders are more common among children with AIS than age-matched controls after controlling for confounding factors. Among a variety of codes included in the dataset, gender, age, insurance type, and residential district codes were selected as variables for multivariable analysis. We obtained adjusted odds ratios for all 5 years.

Ethical Approval

Ethical approval for this study was obtained from the institutional review board of Yonsei University, Gangnam Severance Hospital, Seoul, Korea (IRB# 3-2018-0041).

Statistical Analysis

For this exploratory analysis, we selected clinically meaningful variables among available codes in the dataset, and we performed a univariable logistic regression test for each variable. $P < 0.05$ was used to advance a factor to the multivariable analysis. We performed a multivariable logistic regression test to identify the adjusted OR of psychiatric disorders in children with AIS. All statistical analyses were performed using SAS Enterprise Guide version 7.1 software (SAS Inc).

Results

Prevalence of Psychiatric Disorders

The median (range) prevalence of psychiatric disorders among children with AIS was 7%, (6% to 7%) over 5 years. The median number of children with AIS who had psychiatric disorders was 518 (435 to 526) (Table 1). In all 5 years, anxiety disorders accounted for the greatest prevalence (Fig. 1). The median prevalence of anxiety disorders, behavioral disorders, and mood disorders were 4% (4% to 5%), 3% (2% to 3%), and 2% (2% to 3%), respectively (see Table 1; Supplemental Digital Content 1, http://links.lww.com/CORR/A532).

Table 1. Patient number and prevalence of psychiatric disorders in children with AIS over 5 years

Year	Psychiatric disorders	AIS	% of prevalence
2012	518	7372	7
2013	526	7409	7
2014	525	7656	7
2015	499	7392	7
2016	435	7215	6

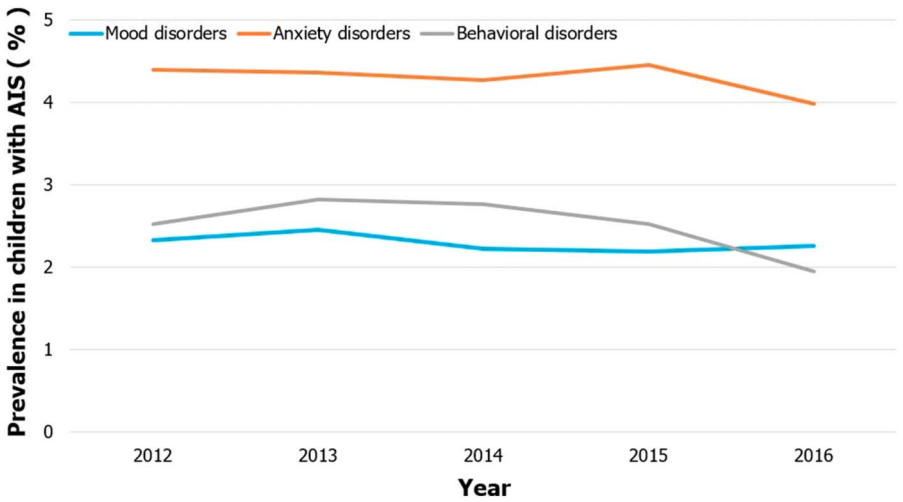

Fig. 1 Prevalence of psychiatric disorders in children with AIS. A color image accompanies the online version of this article.

Are Psychiatric Disorders More Common with AIS Than in Age-matched Controls?

Compared with children who did not have AIS, and after controlling for gender, age, insurance type, and residential district, children with AIS were more likely to have psychiatric disorders in all 5 years (Table 2). Compared with children who did not have AIS, the adjusted ORs of psychiatric disorders in children with AIS ranged from 1.47 to 1.74 (2012: OR 1.60 [95% CI 1.46 to 1.75]; $p < 0.001$; 2013: OR 1.73 [95% CI 1.58 to 1.89]; $p < 0.001$; 2014: OR 1.74 [95% CI 1.59 to 1.91]; $p < 0.001$; 2015: OR 1.71 [95% CI 1.56 to 1.88]; $p < 0.001$; 2016: OR 1.47 [95% CI 1.33 to 1.62]; $p < 0.001$). As an example, in year 2016, the adjusted OR of psychiatric disorders in children with AIS was 1.47 (95% CI 1.33 to 1.62) after controlling for the above variables (Table 3).

Discussion

Poor mental health status among children with AIS has been reported in numerous studies, suggesting low self-esteem, perhaps because of cosmetic concern. However, to our knowledge, there has not been a large-database epidemiologic study on the association between psychiatric disorders and children with AIS. We found that approximately 7% of children with AIS had psychiatric disorders. Second, after controlling for gender, age, insurance type, and residential district, psychiatric disorders were more common among children with AIS than in age-matched controls. Based on these results, it can be suggested that AIS is a risk factor for psychiatric disorders; and therefore, children with AIS and their parents should be counseled about the increased risk of deteriorating mental health of the patients, and surgeons should provide early referral to pediatric psychiatrists.

Limitations

Our study has several limitations. First, since this study was based on diagnostic codes, we could not evaluate the effect of scoliosis severity (based on the Cobb angle) and scoliosis treatment modality, such as surgery or a brace, in relation with psychiatric disorders. Since the registry data did not contain any information about the Cobb angle, surgery history, or

Table 2. Prevalence and adjusted odds ratios of psychiatric disorders in children with AIS compared with age-matched control group over 5 years

Year	AIS group	Control group	Adjusted odds ratio (95% CI)	p value
2012	7 (518 of 7372)	5 (28,226 of 622,110)	1.60 (1.46-1.75)	< 0.001
2013	7 (526 of 7409)	4 (25,701 of 600,233)	1.73 (1.58-1.89)	< 0.001
2014	7 (525 of 7656)	4 (23,973 of 584,709)	1.74 (1.59-1.91)	< 0.001
2015	7 (499 of 7392)	4 (22,917 of 561,352)	1.71 (1.56-1.88)	< 0.001
2016	6 (435 of 7215)	4 (23,074 of 544,680)	1.47 (1.33-1.62)	< 0.001

Data presented as % (n).

Table 3. Multivariable logistic regression analysis of children with AIS compared with control group in year 2016

Parameter	AIS (n = 7215)	Control (n = 544,680)	Adjusted odds ratio (95% CI)	p value
Psychiatric disorders				
Without psychiatric disorders	94 (6780)	96 (521,606)		< 0.001
With psychiatric disorders	6 (435)	4 (23,074)	1.47 (1.33-1.62)	
Gender				
Boys	41 (2938)	51 (280,180)		< 0.001
Girls	59 (4277)	49 (264,500)	1.55 (1.47-1.62)	
Age in years				
10-12	17 (1259)	24 (131,701)		
13-15	35 (2503)	27 (146,425)	1.78 (1.67-1.91)	< 0.001
16-19	48 (3453)	49 (266,554)	1.33 (1.25-1.42)	< 0.001
Insurance type				
National health insurance	97 (6969)	96 (522,639)		
Medical aid	3 (246)	4 (22,041)	0.81 (0.71-0.92)	0.001
Residential district				
Metropolitan	18 (1325)	15 (83,958)		
City	23 (1639)	24 (131,716)	0.79 (0.74-0.85)	< 0.001
Rural	59 (4251)	60 (329,006)	0.83 (0.78-0.88)	< 0.001

Data presented as % (n).

brace treatment, we could not identify or set them as variables. However, we controlled for as many confounders as possible, such as gender, age, insurance type, and residential district. We believe our study is meaningful as it analyzed the overall mental characteristics of children with AIS; further studies will be needed to investigate the effect of detailed variables such as curve type, Cobb angle, and treatment modality. Second, there is a possibility of wrong entry for diagnostic codes. For example, an infantile idiopathic scoliosis patient would be diagnosed with M41.2 (other idiopathic scoliosis) code, and followed over the age of 10 years. In this case, the patient would be included in our study. Also, incorrect psychiatric disorder diagnostic codes could be entered for various reasons. However, we believe the reliability of the diagnostic codes was high, since they are used as evidence in medical lawsuits and medical costs in private and national insurance systems. Furthermore, the proportion of board-certified medical doctors in Korea is also high, at about 80% [17, 22], which makes the diagnosis more accurate. In addition, we excluded diagnostic codes for the other types of scoliosis, such as congenital, neuromuscular, infantile idiopathic, and juvenile idiopathic scoliosis. Therefore, we believe the proportion of other types of scoliosis and inaccurate psychiatric disorder diagnostic codes in our study would be low. Third, there is concern for both selection and transfer bias. This study is not based on the general population, but the population of those who visited a medical institution at least once a year. Therefore, the control group in this study does not strictly represent the general population without certain diseases. In addition, people with diseases who did not visit a medical institute for 1 year would not have been counted. However, due to the low medical cost and high utilization rate of medical institutes in Korea, a large number of people can easily visit medical institutions. Compared with the census data, the estimated proportion of those who had never visited a medical institution was approximately 2% of the total population. This result suggests that the dataset in our study similarly reflects the general population. Lastly, there might be some cultural differences. Compared with physical diseases, psychiatric disorders are more likely to be affected by cultural factors [15]. However, we believe the mental stress of children with AIS due to the deformity itself or treatment process is commonly observed in other cultures as well; therefore, our results may be applied to other cultures. Further studies in populations of other cultures are needed to confirm the difference by cultures or countries.

Prevalence of Psychiatric Disorders

We found that about 7% of children with AIS had psychiatric disorders. In all 5 years from 2012 to 2016, anxiety disorders accounted for the most cases. There were several studies reporting on the prevalence of psychiatric disorders in children. In a Turkish study of 417 children, 14.1% of the population met one or more psychiatric disorder criteria based on questionnaires and interview methods [8]. The most prevalent disorders included anxiety disorders, which

was consistent with our study. The median (range) prevalence of all anxiety disorders in a recent review was 8% (2% to 24%) [6]. Beesdo et al. [4] indicated that the lifetime prevalence of "any anxiety disorder" in studies with children or adolescents is about 15% to 20%, despite notable variation due to variance of methods. The prevalence of behavioral or conduct problems was 7.4%, according to the analysis study of the 2016 National Survey of Children's Health [12]. Farias et al. [9] indicated that the prevalence of depressive disorder in children ranged from 0.5% to 2.5%. A study of depressive disorder in Brazil reported the prevalence as 3.3% to 12.4% in adolescents using the questionnaires method [3]. Overall, we found that the prevalence of any psychiatric disorders or a specific psychiatric disorder can change depending on methodological, regional, economic, and personal factors [12]. In this study, we only included mood disorders, anxiety disorders, and behavioral disorders, as these three categories were most likely to be related to mental stress, and therefore, expected to be related to AIS. Several other pediatric psychiatric disorders, such as organic mental disorders, substance use disorders, schizophrenia, mental retardation, and developmental disorders, were not included in this study. Therefore, caution is needed in interpreting our prevalence results in comparison with other studies. Since our results were based on diagnostic codes entered in medical registry, we believe our results closely reflect the real prevalence of psychiatric disorders in children with AIS. Our results would be useful for surgeons as well as pediatricians and psychiatrists when instructing children with AIS and their parents.

Are Psychiatric Disorders More Common with AIS Than in Age-matched Controls?

After controlling for gender, age, insurance type, and residential district, psychiatric disorders were more common in children with AIS than in children who did not have scoliosis. This was consistent with previous studies that suggested a relationship between AIS and the mental health of patients [11, 33]. In a cross-sectional survey, anxiety and depression were noted both in AIS patients and their parents [33]. Specific factors have been suggested to be causative for the poor mental health of children with AIS. The relationship between depression and brace treatment has been suggested in several studies [18, 27]. However, other studies reported no relationship between brace treatment and self-image or quality of life [14, 29, 30]. Wong et al. [38] suggested an association between back pain and depressive mood in patients with AIS. Several studies indicated that the degree of curve was related to self-image [2, 25]; however, studies showing the opposite result also exist [5, 34]. In many studies, surgery was related to improvement of self-image and quality of life [7, 10, 19, 28]. With regard to behavioral disorders, eating disorders have been reported to be associated with AIS [31, 40]. Through the review of published studies, we found a relationship between AIS and psychiatric disorders but without much robust evidence. In this study, we identified the association between AIS and psychiatric disorders. Psychiatric disorders of young people have increased in recent decades [26]. According to a report by the World Health Organization, psychiatric disorders account for 5 of the 10 leading causes of disability-adjusted life years [23]. Apart from disability, psychiatric disorders also exact a substantial burden on mortality [26]. Considering the seriousness of psychiatric disorders in young people, children with AIS and their parents should be counseled about the increased risk of deteriorating mental health. Also, early intervention is recommended to prevent psychiatric disorders and promote mental well-being in numerous studies [26, 39]. Therefore, we believe that early referral to a specialist of pediatric psychiatric disorders is important. In most clinical practice, surgeons are the ones with whom children with AIS would meet first. Questionnaires, such as the Scoliosis Research Society Outcomes Questionnaire (SRS-22) or the Patient-Reported Outcomes Measurement Information System (PROMIS), are great tools to identify children who may be appropriate for psychiatric referral. Moreover, in-depth consultation with patients and their parents should be considered to identify children with psychiatric disorders other than mood or anxiety disorders, such as behavioral disorders, which we included in our study.

Conclusion

The prevalence of psychiatric disorders in children with AIS was about 7% from 2012 to 2016. After controlling for gender, age, insurance type, and residential district, psychiatric disorders were more common in children with AIS than in children who did not have scoliosis. In the treatment of children with AIS, patients and their parents should be counseled about the increased risk of deteriorating mental health of the patients, and surgeons should provide early referral to pediatric psychiatrists. Further studies should investigate the effect of the factors related to AIS, such as curve type, Cobb angle, and treatment modality.

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