Extent of Depression in Juvenile and Adolescent Patients with Idiopathic Scoliosis During Treatment with Braces

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■ OBJECTIVE: **We compared the depression levels of juvenile and adolescent patients with idiopathic scoliosis who had undergone bracing and identified the factors that influenced the extent of depression in these patients.**

■ METHODS: **Our study included 112 patients with adolescent idiopathic scoliosis (AIS) and 96 patients with juvenile idiopathic scoliosis (JIS). The demographic characteristics and Zung Self-Rating Depression Scale, Strengths and Difficulties Questionnaire, and Center for Epidemiological Studies Depression Scale for Children scores were evaluated to select the relative factors of depression in patients and parents. Cognitive evaluations, using the Wechsler Intelligence Scale for Children—Revised scale, and an independent evaluation using the Functional Independence Measure for Children scale, were conducted.**

■ RESULTS: **The mean Center for Epidemiological Studies Depression Scale for Children score in the AIS group (38.3 ± 3.0) was greater than that in the JIS group (23.8 ± 4.6), a statistically significant difference ($P < 0.05$). Age at initial bracing, bracing duration, parental depression, Cobb angle at initial bracing, cognitive function, independence, peer problems, prosocial behaviors, emotional symptoms, and total difficulties were significant factors in our regression model for JIS. The AIS patients showed similar results, except for the age at initial bracing, cognitive function, and independence.**

■ CONCLUSIONS: **Patients with AIS and JIS who had undergone bracing showed differences in the extent of depression, and female adolescents were more vulnerable to depressive psychological status. Higher levels of cognitive function and independence and older age at bracing, longer bracing duration, larger Cobb angle, negative parental attitudes, and undesirable Strengths and Difficulties Questionnaire scores contributed to greater depression.**

INTRODUCTION

Idiopathic scoliosis (IS) is a common type of spinal deformity in juvenile and adolescent patients, and coronal and sagittal imbalances combined with a distorted appearance of the body have been consistently observed. In addition to the physical disabilities, psychological disturbances and mental disorders in these patients should not be ignored. In 1974, Bengtsson et al.[1] was the first to report that 26 women with severe IS also experienced hypersensitivity, insecurity, and dystrophic moods due to scoliosis. With these results, many studies have closely focused on the psychological changes in patients with IS. In 1988, Kahanovitz and Weiser[2] investigated 72 female patients with adolescent idiopathic scoliosis (AIS) and found that the psychological distress of patients correlated with their parents' attitudes. In 1997, Payne et al.[3] reported the data from 85 patients with AIS and reported that scoliosis was a significant risk factor for psychological issues and health-compromising behaviors.

Key words
- Adolescent
- Depression
- Idiopathic scoliosis
- Juvenile
- Spine

Abbreviations and Acronyms
AIB: Age at initial bracing
AIS: Adolescent idiopathic scoliosis
APE: Age at psychological evaluation
β: Standardized regression coefficient
b: Regression coefficient
CES-DC: Center for Epidemiological Studies Depression Scale for Children
DB: Duration of bracing
IS: Idiopathic scoliosis
JIS: Juvenile idiopathic scoliosis
SDQ: Strengths and Difficulties Questionnaire
WISC-R: Wechsler Intelligence Scale for Children—Revised

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In recent years, the use of bracing in altering the natural history of progressive IS has become almost generally accepted,[4] and it has proved effective in treating mild IS in juveniles and adolescents. Furthermore, the psychological status of patients has also been considered as a factor in evaluating the efficiency of the treatment. Misterska et al.[5] reported that the negative attitudes of parents could increase the risk of psychological impairment of patients undergoing bracing. Glowacki et al.,[6] Law et al.,[7] and Lee et al.[8] observed that the poor psychological outcomes of patients who had undergone bracing correlated significantly with increased severity of the deformity, bracing duration, and patient age.

However, most of the previous studies have used empirical evaluations, and the various scales of evaluation could have made it difficult to achieve consistent results. Few studies have focused on the depression of patients who have undergone bracing, and the extent to which depression results from mental disorders has been poorly understood. To the best of our knowledge, differences in depression between patients with juvenile IS (JIS) and adolescent IS (AIS) who undergo bracing and the factors correlating with depression remain unclear.

In our study, we used the Zung Self-Rating Depression Scale and the Center for Epidemiological Studies Depression Scale for Children (CES-DC) to evaluate the extent of depression. We also used the Strengths and Difficulties Questionnaire (SDQ) to investigate the presence of influential factors. We compared the depression levels of patients with JIS and AIS who had undergone bracing and identified the factors that influenced the extent of depression in these patients.

METHODS

Inclusion and Exclusion Criteria

The cases of patients with JIS and AIS from 2010 to 2016 in our hospital were identified. The major inclusion criteria were a primary diagnosis of AIS or JIS by clinicians, bracing duration of $\geq$1 year, age range 10–16 years, and provision of written informed consent from the patients and their legal guardians. The major exclusion criteria were the presence of any other diagnosed musculoskeletal disease, including spinal deformities; comorbidities that could damage skeletal development, such as neurofibromatosis, multiple myeloma, and ankylosing spondylitis; and any psychiatric or psychological disease that had been diagnosed before bracing had begun.

Demographic Characteristics and Radiographic Evaluations

Data on the age at initial bracing (AIB) and age at the psychological evaluation (APE) were collected. Sex and body mass index data were also recorded. We obtained anteroposterior and whole-spine plain radiographs to evaluate the patients' Cobb angles of the main curves of the spinal scoliosis at the initial bracing. The following equation was used to determine the severity of the IS:

$$SDS_{index} = \frac{SDS_{score}}{80}$$

A score of 0–0.5 indicated a normal range; 0.5–0.59, minimal to mild; 0.6–0.69, moderate to marked; and 0.7–1, severe to extreme.

Psychological Evaluations

In our study, the CES-DC scale was used to evaluate the extent of depression of the patients at the APE. We also used the Zung Self-Rating Depression Scale to evaluate the depression level of patients (and their mother or father), which we also calculated using the Zung Self-Rating Depression Scale. The cognitive degree of function was evaluated using the Wechsler Intelligence Scale for Children–Revised (WISC-R). We also included an independent evaluation using the Functional Independence Measure for Children.

Ethical Statement

The ethics department approved the research protocol. All the participants and their legal guardians provided written informed consent. All the procedures were performed in accordance with the Declaration of Helsinki and relevant policies.

Statistical Analysis

The data were analyzed using the SPSS statistical analysis software, version 13.0 (IBM Corp., Armonk, New York, USA). A comparison analysis was performed between the JIS and AIS groups. The quantitative data were analyzed using the Student t test, and the classic data were analyzed using the Wilcoxon signed-rank test. The factors influencing the development of depression were selected using stepwise linear regression analysis. Differences were considered statistically significant at $P < 0.05$.

RESULTS

We included 276 patients in the present study; however, 68 patients did not complete the psychological evaluations. Thus, 112 patients with AIS and 96 patients with JIS were included in our study. Of the 96 patients with JIS, 25 were male and 71 were female. Of the 112 patients with AIS, 16 were male and 96 were female. No statistically significant differences were found in the proportion of male and female patients in the JIS and AIS groups ($P = 0.34$). The mean duration of bracing (DB) was 3.3 ± 1.4 years and 3.1 ± 1.1 years in the JIS and AIS groups, respectively, without a statistically significant difference ($P = 0.250$). The average Cobb angle before bracing was $29.8° \pm 2.6°$ in the JIS group and $31.4° \pm 3.8°$ in the AIS group, with a statistically significant difference between the 2 groups ($P = 0.0006$). Evaluation of the extent of depression using the CES-DC scale indicated that the patients with JIS had a lower degree of depression compared with that of the patients with AIS ($P < 0.0001$); the parents of the 2 groups showed statistically significant differences ($P = 0.386$). The cognitive function and independence levels of the patients with JIS were both lower than those for the patients with AIS (Table 1).

We used the SDQ scale to evaluate the patients with JIS and AIS. The average score for the total difficulties, emotional symptoms, peer problems, and prosocial behaviors was greater for the patients with AIS compared with the average score of the patients with JIS ($P < 0.05$). Differences in the conduct problem scores and

Table 1. Demographic Characteristics

Variable	AIS Group	JIS Group	*P* Value
Age at initial bracing (years)	13.7±2.2	7.4±1.6	<0.0001
Sex (*n*)			0.34
Female	96	71	
Male	16	25	
BMI (kg/m^2)	19.8 ± 1.7	18.6 ± 0.8	<0.0001
Initial Cobb angle (°)	31.4 ± 3.8	29.8 ± 2.6	0.0006
Bracing duration (years)	3.1 ± 1.1	3.3 ± 1.4	0.250
Cognitive score	93.4 ± 4.1	88.3 ± 4.1	<0.0001
Independence score	113.7 ± 7.6	84.9 ± 8.5	<0.0001
Parental SDS score	0.8 ± 0.2	0.7 ± 1.2	0.386
Patient CES-DC score	38.3 ± 3.0	23.8 ± 4.6	<0.0001

Data presented as mean ± standard deviation or number of patients.
AIS, adolescent idiopathic scoliosis; JIS, juvenile idiopathic scoliosis; BMI, body mass index; SDS, Zung Self-Rating Depression Scale; CES-DC, Center for Epidemiological Studies Depression Scale for Children.

hyperactivity levels were not statistically different between the JIS and AIS groups ($P > 0.05$; Table 2). The female patients exhibited a greater extent of depression compared with the male patients in both AIS and JIS groups ($P < 0.05$; Figure 1).

We performed separate linear regression analyses of the data from the patients with JIS and AIS to identify the factors that influenced the extent of depression. For all patients, AIB, APE, body mass index, Cobb angle at AIB, DB, cognitive function, independence, depression of parents, and the items of the SDQ were included in our linear regression model for selection. For the patients with JIS, the factors finally entered into our model were as follows: AIB (regression coefficient [b] = 0.272; standardized regression coefficient [β] = 0.807; $P < 0.0001$), DB (b = 0.180; β = 0.606; $P = 0.038$), parental depression (b = 0.200; β = 4.791; $P = 0.04$), Cobb angle at AIB (b = 0.321; β = 0.572; $P < 0.0001$), cognitive function (b = 0.191; β = 0.218; $P = 0.042$), independence (b = 0.399; β = 0.217; $P < 0.0001$), peer problems (b = 0.229; β = 0.586; $P = 0.035$), prosocial behaviors (b = −0.09; β = −0.038; $P = 0.046$), emotional symptoms (b = 0.063; β = 0.103; $P < 0.0001$), and total difficulties (b = 0.430; β = 0.548; $P < 0.0001$; Table 3). For the patients with AIS, the factors finally entered into the model were as follows: DB (b = 0.218; β = 0.569; $P = 0.029$), parental depression (b = 0.260; β = 0.662; $P = 0.002$), Cobb angle at AIB (b = 0.365; β = 0.288; $P < 0.0001$), peer problems (b = 0.389; β = 0.618; $P < 0.0001$), prosocial behaviors (b = −0.273; β = −0.118; $P < 0.0001$), emotional symptoms (b = 0.475; β = 0.947; $P < 0.0001$), and total difficulties (b = 0.010; β = 0.052; $P = 0.077$; Table 3).

Table 2. Strengths and Difficulties Questionnaire Scale

SDQ Domain	AIS Group	JIS Group	*P* Value
Total difficulties	29.3 ± 5.8	25.1 ± 3.1	<0.0001
Emotional symptom	7.7 ± 1.5	5.3 ± 0.1	<0.0001
Peer problems	7.6 ± 1.4	5.0 ± 0.6	<0.0001
Prosocial behavior	2.7 ± 0.5	4.2 ± 0.3	<0.0001
Conduct problems	2.0 ± 0.6	1.9 ± 0.2	0.120
Hyperactivity	3.6 ± 0.5	3.5 ± 1.1	0.39

Data presented as mean ± standard deviation.
SDQ, Strengths and Difficulties Questionnaire; AIS, adolescent idiopathic scoliosis; JIS, juvenile idiopathic scoliosis.

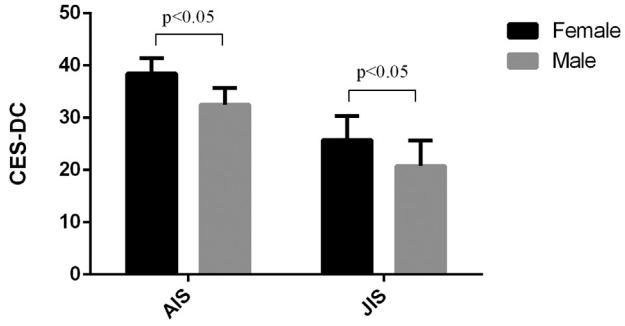

Figure 1. Comparison of extent of depression stratified by sex in the adolescent idiopathic scoliosis (AIS) and juvenile idiopathic scoliosis (JIS) groups.

DISCUSSION

In our study, we compared the extent of depression in patients with JIS and AIS. We also investigated the factors that could influence the extent of depression. The patients with JIS had a lower extent of depression compared with the patients with AIS. The factors that correlated with the extent of depression in those with JIS were AIB, DB, depression status of the parents, Cobb angle at the AIB, cognitive function, independence, peer problems, prosocial behaviors, emotional symptoms, and total difficulties. Similar results were found for the patients with AIS, except for AIB, cognitive function, and independence. Differences in the extent of depression when stratified by sex were revealed, especially in adolescents.

Our results showed that an earlier AIB, a lower degree of cognitive function, and a lower extent of independence contributed to a lower level of depression in the patients with JIS but not in those with AIS. We postulated that younger patients would tend to present with lower levels of cognitive function and independence and older patients would exhibit opposing symptoms. Similar results were reported by Bengtsson et al.[1] in 1974, and the correlation between the level of cognitive function and the presence of a psychological handicap showed patients were less well-adjusted. Talić et al.[9] also performed a nationwide, population-based cohort study in Taiwan and found that a greater risk of depression correlated with increased patient age. Korovessis et al.[10] reported that patients were more ashamed of their body shape and more concerned about their future

Table 3. Results of Linear Regression Analysis

Variable	AIS Group	JIS Group
Age at initial bracing	NA	
β		0.807
b		0.272
P value		<0.0001
Initial Cobb angle		
β	0.288	0.572
b	0.365	0.321
P value	<0.0001	<0.0001
Duration of bracing		
β	0.569	0.606
b	0.218	0.180
P value	0.029	0.038
Cognitive	NA	
β		0.218
b		0.191
P value		0.042
Independence	NA	
β		0.217
b		0.399
P value		<0.0001
SDS of parents		
β	0.662	4.791
b	0.260	0.200
P value	0.002	0.04
Total difficulties		
β	0.052	0.548
b	0.010	0.430
P value	0.077	<0.0001
Emotional symptoms		
β	0.947	0.103
b	0.475	0.063
P value	<0.0001	<0.0001
Peer problems		
β	0.618	0.586
b	0.389	0.229
P value	<0.0001	0.035
Prosocial behavior		
β	−0.118	−0.038
b	−0.273	−0.09
P value	<0.0001	0.046

AIS, adolescent idiopathic scoliosis; JIS, juvenile idiopathic scoliosis; NA, not applicable; β, standardized regression coefficient; b, regression coefficient; SDS, Zung Self-Rating Depression Scale.

appearance. However, Morley et al.[11] empirically argued that early, maladaptive cognitive patterns were associated with a vulnerability for developing depression. However, few clinical studies have focused on the relationship between cognitive function and depression, and independent factors have not been previously reported. Thus, further studies are needed.

According to our study, a larger Cobb angle and a longer DB increased the severity of depression for both patients with JIS and patients with AIS. The severity of scoliosis was calculated using the Cobb angle, and a larger Cobb angle led to a more distorted appearance. The wearing of a bulky, orthotic brace could also lead to an unpleasant appearance.[7] Tones et al.[12] reported that personal reflections on bracing were associated with poor emotional well-being. Matsunaga et al.[13] and Chang et al.[14] suggested that bracing treatment would cause emotional distress in patients with IS. Glowacki et al.[6] also reported that patients who underwent bracing would experience a significant period of stress, a decrease in self-esteem, and feelings of isolation because of their outward appearance. In our study, the DB correlated more positively with the extent of depression in patients with AIS than in those with JIS. The same results were observed by Clayson et al.,[15] who reported that younger adolescents exhibited fewer psychologically debilitating effects. Schwieger et al.[16] reported that younger patients could develop self-protecting and coping strategies to adapt to their new body image. The patients with JIS had received conservative treatments for longer periods than those with AIS, which caused the DB to correlate more positively with the extent of depression in patients with AIS than in those with JIS. Another explanation is that older adolescent patients are more aware of their body shape and whether it was appealing and healthy.[3,12,17]

Abnormal scores for the domains of peer problems, prosocial behaviors, emotional symptoms, and total difficulties in the SDQ contributed to a greater extent of depression in our study. Danielsson et al.[18] conducted a survey that revealed that patients who were experiencing isolation or depression would also have reduced participation in hobbies and extracurricular activities or dating, with an incidence ranging from 25% to 43%. Hearst et al.[19] and Glowacki et al.[6] reported that patients with disfigurements had a high risk of teasing from their peers and had impairments in social adjustment and experienced social anxiety and behavioral problems as a result. All these vulnerability–stress interactions result in a tendency to develop depression.[20] Hankin et al.[21] reported that experiences of peer rejection and victimization would lead to an exacerbation of cognitive vulnerabilities and would eventually cause depression.

We also evaluated the extent of depression in the patients' parents, and a positive correlation was found in both groups.

Thus, parental attitudes can influence the psychological health of the patients. Several studies have reported results consistent with our findings. Kahanovitz et al.[2] and Tones et al.[12] reported that the good attitudes of parents regarding their child's scoliosis showed positive correlations with the attitudes of the patients who had undergone bracing regarding scoliosis. Glowacki et al.[6] also reported that patients and their parents perceived the mental health of the patients similarly. Misterska et al.[5] suggested that parental mental support would decrease the risk of impairment in the patients (especially older adolescents).

In our study, significant differences were found in the extent of depression in both the JIS and the AIS group when stratified by sex. Female patients tended to experience greater depression than did the male patients. Korovessis et al.[10] also reported that girls had lower compliance with of the use of bracing compared with boys. Lee et al.[8] reported that girls with scoliosis were more concerned with their appearance than were boys with scoliosis. Matsunaga et al.[13] and Kahanovitz et al.[2] suggested that the factors that resulted in depression differed between the sexes. Specifically, male patients were more concerned with self-acceptance and female patients were more concerned with acceptance by other individuals.[2,13]

The characteristics with the greatest difference between the patients with JIS and those with AIS were patient age at the initial diagnosis of IS and patient age at the initiation of bracing. Juvenile patients had lower levels of cognitive function than the older adolescents. Several empirical theories concerning the relationship between depression and cognitive function have been proposed and accepted. A cognitive theory and a helplessness theory reported by Haaga and Beck[22] and Abramson et al.[23] suggested that distorted cognition combined with negative life events were likely to result in vulnerability and a greater risk of depression. The response styles theory, reviewed by Lakdawalla et al.,[20] posited that the 3 main response styles, rumination, distraction, and problem-solving, determined the severity and duration of depression in patients. Rumination contributed to a more depressed mood by the maintenance of a depressed mood and interference with psychological intervention. These theories could explain the results we found in our study. Adolescents are at the most sensitive stage, and any event could cause psychological fluctuations.[8,18,21] Scoliosis and bracing treatment could be considered negative events by the patients that had caused their disfigurement. This was more prevalent for adolescents than for juveniles and led to more depressed moods in the adolescents. Adolescent patients, especially female adolescents, reported rumination toward peers and negative parental attitudes, which could aggravate the extent of their depression.[20]

Depression has been proved to cause morbidity and mortality, increasing the burden on both families and society.[24,25] Sims et al.,[26] Gladstone et al.,[27] and Carnevale[28] suggested that earlier interventions for patients at high risk of depression would decrease the prevalence of depression. Such interventions include universal, selective, and indicated prevention programs, which have been demonstrated to be effective by the Institute of Medicine. In our study, the patients with AIS and those with JIS patients who had undergone bracing exhibited varying degrees of depressed conditions. Prevention might be more cost-effective than waiting until the conditions have developed and then providing an intervention.[29] Thus, we have provided the following suggestions. First, a psychological evaluation should be performed. Each patient should undergo a depression evaluation at each follow-up examination, and the patients' parents should also be evaluated. Second, psychological intervention is necessary. We asked the psychologist at our hospital for assistance, and patients, as well as their parents, should receive therapy. Third, parents should talk to the teachers at the patient's school, with a suggestion that the teachers focus on the patient's mental status and behavior and offer help to the patient. Our future studies will focus on the efficiency and efficacy of prevention of depression in patients with AIS and JIS.

However, our study had several limitations. First, we only focused on the psychological status of patients who had undergone bracing and did not consider the mental status of patients who had received an initial diagnosis of scoliosis. Therefore, it would be difficult to identify whether bracing was the initial factor resulting in depression or a deteriorating factor of depression. Second, our research did not include age- and sex-matched normal patients as a control group, which could have decreased the power of our validation. Third, we evaluated the extent of depression in our patients at a single point. However, regular follow-up examinations would be better for evaluation.

CONCLUSIONS

In our study, juveniles and adolescents with IS who had undergone bracing exhibited differences in the extent of depression, and female adolescents were more vulnerable to a depressed psychological status. Higher levels of cognitive function and independence, older age at the initiation of treatment, a longer DB, a larger Cobb angle, negative parental attitudes, and undesirable scores for the peer problems, prosocial behaviors, emotional symptoms, and total difficulties domains resulted in a greater incidence of depression. Timely psychological interventions should be conducted to prevent depression in patients with IS, especially female adolescent patients.

REFERENCES

1. Bengtsson G, Fällström K, Jansson B, et al. A psychological and psychiatric investigation of the adjustment of female scoliosis patients. *Acta Psychiatr Scand*. 1974;50:50-59.

2. Kahanovitz N, Weiser S. The psychological impact of idiopathic scoliosis on the adolescent female: a preliminary multi-center study. *Spine (Phila Pa 1976)*. 1989;14:483-485.

3. Payne WK, Ogilvie JW, Resnick MD, et al. Does scoliosis have a psychological impact and does gender make a difference? *Spine (Phila Pa 1976)*. 1997;22:1380-1384.

4. Helfenstein A, Lankes M, Öhlert K, et al. The objective determination of compliance in treatment of adolescent idiopathic scoliosis with spinal orthoses. *Spine (Phila Pa 1976)*. 2006;31:339-344.

5. Misterska E, Glowacki M, Adamczyk K, et al. Patients' and parents' perceptions of appearance in scoliosis treated with a brace: a cross-sectional analysis. *J Child Fam Stud*. 2014;23:1163-1171.

6. Glowacki M, Misterska E, Adamczyk K, et al. Changes in scoliosis patient and parental assessment of mental health in the course of Cheneau brace treatment based on the strengths and difficulties questionnaire. *J Dev Phys Disabil*. 2013;25:325-342.

7. Law D, Cheung M, Yip J, et al. Scoliosis brace design: influence of visual aesthetics on user

acceptance and compliance. *Ergonomics*. 2016;139:1-11.

8. Lee H, Choi J, Hwang J-H, Park JH. Health-related quality of life of adolescents conservatively treated for idiopathic scoliosis in Korea: a cross-sectional study. *AORN J*. 2016;90:347-380.

9. Talić G, Ostojić L, Bursać SN, et al. Idiopathic scoliosis from psychopathological and mind-body medicine perspectives. *Psychiatr Danub*. 2016;28:357-362.

10. Korovessis P, Zacharatos S, Koureas G, et al. Comparative multifactorial analysis of the effects of idiopathic adolescent scoliosis and Scheuermann kyphosis on the self-perceived health status of adolescents treated with brace. *Eur Spine J*. 2007;16:537-546.

11. Morley TE, Moran G. The origins of cognitive vulnerability in early childhood: mechanisms linking early attachment to later depression. *Clin Psychol Rev*. 2011;31:1071-1082.

12. Tones M, Moss N, Polly DW. A review of quality of life and psychosocial issues in scoliosis. *Spine (Phila Pa 1976)*. 2006;31:3027-3038.

13. Matsunaga S, Hayashi K, Naruo T, et al. Psychologic management of brace therapy for patients with idiopathic scoliosis. *Spine (Phila Pa 1976)*. 2005;30:547-550.

14. Chang W-P, Lin Y, Huang H-L, et al. Scoliosis and the subsequent risk of depression: a nationwide population-based cohort study in Taiwan. *Spine (Phila Pa 1976)*. 2016;41:253-258.

15. Clayson D, Mahon B, Levine D. Preoperative personality characteristics as predictors of postoperative physical and psychological patterns in scoliosis. *Spine (Phila Pa 1976)*. 1981;6:9-12.

16. Schwieger T, Campo S, Weinstein SL, et al. Body image and quality-of-life in untreated versus brace-treated females with adolescent idiopathic scoliosis. *Spine (Phila Pa 1976)*. 2016;41:311-319.

17. Eliason MJ, Richman LC. Psychological effects of idiopathic adolescent scoliosis. *J Dev Behav Pediatr*. 1984;5:169-172.

18. Danielsson AJ, Wiklund I, Pehrsson K, et al. Health-related quality of life in patients with adolescent idiopathic scoliosis: a matched follow-up at least 20 years after treatment with brace or surgery. *Eur Spine J*. 2001;10:278-288.

19. Hearst D. Can't they like me as I am? Psychological interventions for children and young people with congenital visible disfigurement. *Dev Neurorehabil*. 2007;10:105-112.

20. Lakdawalla Z, Hankin BL, Mermelstein R. Cognitive theories of depression in children and adolescents: a conceptual and quantitative review. *Clin Child Fam Psychol Rev*. 2007;10:1-24.

21. Hankin BL, Oppenheimer C, Jenness J, et al. Developmental origins of cognitive vulnerabilities to depression: review of processes contributing to stability and change across time. *J Clin Psychol*. 2009;65:1327-1338.

22. Haaga DAF, Beck AT. Perspectives on depressive realism: implications for cognitive theory of depression. *Behav Res Ther*. 1995;33:41-48.

23. Hankin BL, Abramson LY, Moffitt TE, Silva PA, McGee R, Angell KE. Development of depression from preadolescence to young adulthood: emerging gender differences in a 10-year longitudinal study. *J Abnorm Psychol*. 1998;107:128-140.

24. Thapar A, Collishaw S, Pine DS, Thapar AK. Depression in adolescence. *Lancet*. 2012;379:1056-1067.

25. Barrera M. Directions for expanding the prevention of depression in children and adolescents. *Am J Prev Med*. 2006;31(suppl 1):184-185.

26. Sims BE, Nottelmann E, Koretz D, et al. Prevention of depression in children and adolescents. *Am J Prev Med*. 2006;31(suppl 1):99-103.

27. Gladstone TRG, Beardslee WR. The prevention of depression in children and adolescents: a review. *Can J Psychiatry*. 2009;54:212-221.

28. Carnevale TD. Universal adolescent depression prevention programs: a review. *J Sch Nurs*. 2013;29:181-195.

29. Yu ZJ, Mooreville M, Weller RA, et al. Long-term treatment of pediatric depression with psychotherapies. *Curr Psychiatry Rep*. 2011;13:116-121.

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