Brace-Related Stress and Quality-of-Life Parameters in Adolescents with Idiopathic Scoliosis

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Abstract:

Introduction: This study investigated brace-related stress, trunk appearance perception, and quality of life in adolescent girls with idiopathic scoliosis who wear the Milwaukee brace for treatment.

Methods: Fifty-two adolescent girls with idiopathic scoliosis participated in this study. They had been under treatment with Milwaukee brace for at least three months. They filled out four questionnaires, including the revised 22-item Scoliosis Research Society questionnaire (SRS-22r), the Brace Questionnaire (BrQ), the Bad Sobernheim Stress Questionnaire-Brace (BSSQ-Brace), and the Trunk Appearance Perception Scale (TAPS).

Results: Twenty participants had high stress levels, and thirty-two had moderate stress levels. The total score and emotional and social function scores of the BrQ were significantly higher in participants with high stress compared to those with moderate stress. There was no significant difference between the two groups in the SRS-22r and TAPS questionnaires scores. However, a high Cobb angle had significantly worsened their perception of trunk appearance.

Conclusions: It seems that among quality-of-life parameters, social and emotional functions are more affected by stress level in treating adolescent girls with idiopathic scoliosis with a brace. In addition, patients with high stress levels have a worse perception of their trunk appearance.

Keywords: Adolescent idiopathic scoliosis, Quality of life, Brace, Stress, Trunk perception

Introduction

Adolescent idiopathic scoliosis (AIS) affects 0.5%-5.2% of children aged 10-16 years globally. It is a progressive disease associated with psychosocial consequences. Bracing is the most common nonsurgical treatment for immature individuals with AIS to control further curve progression. The quality of life of individuals with AIS can be affected by scoliosis itself and therapeutic interventions such as bracing. Still, the impact of bracing on health-related quality-of-life parameters on individuals with AIS is controversial. Some studies show that bracing has no side effects on health-related quality-of-life parameters in individuals with AIS. Others reported that wearing a brace may lead to various psychological reactions such as negative thoughts, stress and anxiety, emotional instability, and disturbance of self-image or self-esteem of individuals with AIS. These differences might be due to the level of satisfaction with management, severity of scoliosis curvature, brace type, cultural differences, and brace-related stress. In some societies, individuals use a special cover when they appear in the society to hide the brace underneath the dress and therefore reduce the psychological effect of the brace.

The perceived trunk aesthetics is a main aspect when evaluating health-related quality of life in individuals with AIS. Being unhappy about body image is an issue of concern for individuals with AIS. They may perceive abnormal changes in their anatomies and may differentiate themselves to adolescents with no spinal deformity. In adolescent girls, an unfavorable self-assessment of appearance may lead
to a different feeling regarding trunk shape, like body displeasure, negative self-image, and body size. Previous studies have shown the effectiveness of the Milwaukee brace in halting curve progression in AIS. It should be noted that wearing a body brace such as a Milwaukee brace may have a more negative effect on self-image of adolescent girls with idiopathic scoliosis and may increase their stress levels.

The results of the previous studies revealed that the neck ring of the Milwaukee brace has a negative effect on the patient’s self-image. Misterska et al. studied 30 adults with idiopathic scoliosis and reported that even 20 years after treatment with a Milwaukee brace, patients are still stressed and worried about body appearance, shoulder level, back asymmetry, body curve, and rib hump. Therefore, owing to its negative effect on patients’ psychosocial parameters, it is not used on individuals with AIS that have a curve apex at or above T8.

Considering stress and other psychological effects of bracing is important because it can be a leading cause of rejection of brace treatment in individuals with AIS. Accordingly, it is necessary to evaluate the psychological burden created by bracing to provide appropriate psychological support for better compliance by individuals. However, few studies have evaluated Milwaukee brace-related stress while wearing it in AIS.

Therefore, this study investigated brace-related stress and perceptions of trunk deformity in adolescent girls with idiopathic scoliosis who wore a Milwaukee brace. Moreover, we assessed quality-of-life parameters based on brace-related stress.

Materials and Methods

Study design

A total of 52 consecutive adolescent girls with idiopathic scoliosis were invited to participate in this cross-sectional study. They had all referred to our rehabilitation center for treatment. The inclusion criteria were the following: 1) being 10-18 years old, 2) having idiopathic scoliosis with a main thoracic curve (Lenke type I with an apex above T8) of 20°-45° confirmed by a senior fellow spinal orthopedic surgeon and a prescription for a Milwaukee brace, 3) being at least 10 years old at the beginning of brace treatment, 4) having worn the brace for at least one month, and 5) having no history of surgical treatment on the spine. All participants signed written informed consent to take part in the study. This research was approved by the IRB of the authors’ affiliated institution.

Protocol

A Milwaukee brace was fitted for each patient, a device that is prescribed for individuals with AIS with various curve patterns and an apex at or above T8. The brace was manufactured for each patient individually by a skilled orthotist. To achieve the optimum outcome, the patients were asked to wear the brace full-time (23 hours per day) and the corrective pads of the brace were adjusted every three to four months to exert continuous maximal pressure.

Outcome measures

All participants answered the Persian versions of three questionnaires: 1) the revised 22-item Scoliosis Research Society (SRS-22r) questionnaire, 2) the Bad Sobernheim Stress Questionnaire-Brace (BSSQ-Brace), and 3) the Brace Questionnaire (BrQ). Furthermore, they filled out the trunk appearance perception scale (TAPS) to evaluate their perception of trunk deformity.

The SRS-22r is a specific self-report questionnaire that assesses the outcomes of patients with idiopathic scoliosis. It consists of 22 items in five sections: function/activity (five items), pain (five items), self-image (five items), mental health (five items), and satisfaction with management (two items). The questions are answered based on a five-point Likert scale with scores ranging from 1 to 5 for each question and from 5 to 25 for each section (except for the satisfaction section with a score of 2-10). A higher score means a better quality of life. This questionnaire is widely used for measuring quality of life in infantile, juvenile, adolescent, and adult scoliosis.

The BrQ also evaluates the quality-of-life parameters in patients with idiopathic scoliosis who are treated with a brace. It has 34 items in eight sections: general health (two items), physical function (seven items), emotional function (five items), self-esteem and aesthetics (two items), vitality (two items), school activity (three items), physical pain (six items), and social function (seven items). Each item is scored based on a five-point Likert scale from 1 to 5. Its minimum total score is 20, and the maximum score is 100. A higher score means a better quality of life.

The BSSQ-Brace evaluates the psychosocial stress level of patients with idiopathic scoliosis who are treated with a brace. It has eight items that are scored based on a four-point Likert scale, ranging from 0 (highest level of stress) to 3 (lowest level of stress). Its total score ranges from 0 to 24, in which 0-8 indicates a high level of stress, 9-16 means a moderate level of stress, and 17-24 shows a low level of stress.

The TAPS is a three-item drawing-based tool to evaluate the scoliosis patients’ perception of trunk deformity. Each drawing item is scored from 1 (maximum deformity) to 5 (minimum deformity). It was introduced by Bagó et al. with a satisfactory internal consistency (a Cronbach’s alpha coefficient of 0.89), test-retest reliability (an intraclass correlation coefficient of 0.92), and adequate responsiveness (an effect size of 1.96 and a standardized response mean of 1.73). Finally, the participants and their parents were asked to report the hours that the brace was worn per day to evaluate compliance.

Statistical analyses

We used the Statistical Package for Social Sciences
(SPSS) software version 20 to conduct statistical analyses. The significance level was 0.05 for all analyses. The demographic characteristics of the participants were reported as mean, standard deviation (SD), and range. The distributions of the SRS-22, BrQ, BSSQ-Brace, and TAPS were overly normal based on Kolmogorov-Smirnov test (P<0.05). Therefore, the independent sample t test was used to compare quality-of-life parameters between participants with high and moderate stress levels, age, and brace wearing time. The participants were categorized according to their age (10-13 and >13 years) as well as the time they had worn the brace (6-12 months versus more than 12 months). Pearson’s correlation coefficient was used to evaluate the relationship between quality-of-life parameters and stress level. We conducted a one-way between-groups multivariate analysis of variance to assess which quality-of-life parameter is more affected by stress level.

### Results

A total of 52 girls with idiopathic scoliosis participated in this study. All of them filled out the questionnaires accurately. The mean age was 12.9±1.9 years (10-18 years). The mean Cobb angle was 33.7°±6.7° (20°-44°) (Table 1). A total of 20 participants (38%) had a high level of brace-related stress with an average score of 5.75 (range of 2-8), and 32 participants (62%) had a moderate level of stress with an average score of 12.28 (range of 9-16).

The participants with high stress levels were significantly different in the total score and emotional and social functioning domains of the BrQ compared to those with moderate level of stresses (Fig. 1). However, concerning the SRS-22r (Fig. 2) and TAPS (Fig. 3) questionnaires, there was no significant difference between the two groups.

Regarding BrQ, stress level was significantly correlated with emotional function (r=0.001), school activity (0.005), social function (P<0.001), and total scores (P<0.001). Considering the SRS-22r questionnaire, the results of the Pearson’s correlation analysis demonstrated that stress level was significantly correlated with self-image (P=0.03), satisfaction (P=0.05), and total score (P=0.04). Concerning the total score of the TAPS questionnaire, there was no significant correlation between the stress level and body morphology perception of the participants (Table 2).

Table 3 shows comparisons of summary statistics for stress level, quality-of-life parameters, and brace compliance. Close inspection of this table shows a significant, negative correlation between brace compliance and the emotional functioning domain of the BrQ (P=0.03).

We conducted a one-way between-groups multivariate analysis of variance to investigate quality-of-life parameters in two groups of participants with high and moderate stress levels. We used 11 dependent variables: physical functioning, social functioning, emotional functioning, vitality, school activity, bodily pain, self-image, mental health, satisfaction, and total scores of BrQ and SRS-22r (Table 4). The independent variable was stress level. Testing the preliminary assumption regarding normality, linearity, univariate and multivariate outliers, homogeneity of variance-covariance matrices, and multicollinearity showed no serious violations. The combined dependent variables were significantly worsened in patients with high stress compared to those with moderate stress (F (11, 40)=2.28, P=0.028, Wilks’ lambda=0.61, and partial eta squared=0.38). When the results for the dependent variable were considered separately, the only difference for reaching a statistical significance with a Bonferroni adjusted alpha level of 0.004 was the perceived social functioning with F (1, 50)=12.84, P= 0.001, and partial eta squared=0.20, and emotional functioning with F (1, 50)=12.97, P=0.001, and partial eta squared= 0.20. An assessment of the mean scores showed that the emotional and social functions were more affected by a high stress level.

Quality-of-life parameters were evaluated based on the severity of the major scoliosis curve. There were 18 cases with a major Cobb angle≤30° and 34 cases with a Cobb angle>30°. Participants with major severity had a significantly worse perception of themselves than those with minor severity (Table 5).

We conducted an independent sample t-test to compare the quality-of-life parameters and stress scores for participants who were 10-13 and >13 years old. There were significant differences in self-image, school activity, and social functioning between the two groups (Table 6). Regarding duration of brace treatment, a significant difference was found in the self-esteem and aesthetic domains of the BrQ between the two groups (Table 6).

### Table 1. Demographic and Clinical Characteristics of the Studied Sample (n=52).

| Variables                        | Mean   | Standard deviation | Range  |
|---------------------------------|--------|--------------------|--------|
| Age (yrs.)                      | 12.96  | 1.98               | 10-18  |
| Height (cm)                     | 160.17 | 9.98               | 130-180|
| Body mass index (kg/m²)         | 19.58  | 2.89               | 14.69-26.23|
| Weight (kg)                     | 50.56  | 10.18              | 25-72  |
| Duration of brace treatment (month) | 13.57  | 8.34               | 1-48   |
| Compliance (hours/day)          | 19.88  | 4.48               | 8-24   |
| Cobb angle (degree)             | 33.73  | 6.72               | 20-44  |

Table 3 shows comparisons of summary statistics for...
Figure 1. Effects of different stress levels on quality-of-life parameters in patients with adolescent idiopathic scoliosis based on the Brace Questionnaire (BrQ).

Figure 2. Effects of different stress levels on quality-of-life parameters in patients with adolescent idiopathic scoliosis based on the 22-item Scoliosis Research Society questionnaire (SRS-22).
Figure 3. Effects of level of stress on the Trunk Appearance Perception Scale (TAPS) in patients with adolescent idiopathic scoliosis.

Table 2. Pearson’s Correlation Coefficient between Stress Level and Quality-of-Life Parameters.

| Variables                        | $r$  | $p$  |
|---------------------------------|------|------|
| Brace questionnaire             | 0.14 | 0.31 |
| General health                  | 0.23 | 0.97 |
| Physical functioning            | 0.53 | <0.001|
| Emotional functioning           | 0.08 | 0.57 |
| Vitality                        | 0.21 | 0.12 |
| School activity                 | 0.38 | 0.005|
| Bodily pain                     | 0.26 | 0.05 |
| Social functioning              | 0.52 | <0.001|
| Total                           | 0.47 | <0.001|
| Scoliosis Research Society-22  |      |      |
| Function/activity               | 0.09 | 0.51 |
| Pain                            | 0.04 | 0.77 |
| Self-image                      | 0.29 | 0.03 |
| Mental health                   | 0.25 | 0.06 |
| Satisfaction                    | 0.27 | 0.05 |
| Total                           | 0.28 | 0.04 |
| Trunk Appearance Perception Scale | -0.01 | 0.90 |

Table 3. Relationships between Stress Level, Quality-of-Life Parameters, and Brace Compliance.

| Variables                        | $r$  | $p$  |
|---------------------------------|------|------|
| Brace questionnaire             | 0.15 | 0.28 |
| General health                  | 0.13 | 0.34 |
| Physical functioning            | 0.10 | 0.45 |
| Emotional functioning           | 0.13 | 0.35 |
| Self-esteem and esthetics       | -0.20| 0.14 |
| Vitality                        | -0.08| 0.57 |
| School activity                 | 0.25 | 0.06 |
| Bodily pain                     | 0.13 | 0.34 |
| Social functioning              | 0.10 | 0.45 |
| Mental health                   | 0.13 | 0.35 |
| Satisfaction                    | -0.02| 0.14 |
| Total                           | 0.08 | 0.57 |
| Trunk Appearance Perception Scale | -0.26| 0.05 |
| Bad Sobernheim Stress Questionnaire-Brace | -0.03| 0.79 |

Discussion

Evaluating health-related quality-of-life parameters is an important way to understand the effectiveness of brace treatment on AIS\(^28\). This seems to be the first study that has investigated the quality-of-life parameters of adolescent girls with idiopathic scoliosis with high and moderate stress levels who are under brace treatment. We found that the emotional and social functions of individuals with AIS are more affected by wearing the Milwaukee brace. Perception of trunk deformity in participants with Cobb angles of $>30^\circ$ was greater than those with Cobb angles of $<30^\circ$.

Our findings showed that brace-related stress can deteriorate the emotional and social functions of individuals with AIS. Our results are consistent with Khoshhal et al.’s results\(^72\). They suggested that there is a significant relationship
between stress level and the score obtained from the BrQ questionnaire. However, none of the quality-of-life parameters were significantly affected by bracing based on SRS-22 possibly because of structural differences between the BrQ and SRS-22 questionnaires. BrQ is designed specifically for individuals with AIS treated with a brace\(^\text{28}\), whereas SRS-22 is primarily designed for patients who have undergone scoliosis surgery\(^\text{33}\). This questionnaire has also been used for scoliosis patients who do not do surgery\(^\text{34-36}\). The results of a Rasch analysis study showed that SRS-22 lacks rich metric properties to measure health-related quality of life of individuals with AIS\(^\text{37}\). To address this problem based on the Rasch model, the seven-item Scoliosis Research Society (SRS-7) questionnaire was designed based on the original SRS-22. It had better performance though its metric properties were not satisfactory\(^\text{38}\). According to our results, BrQ was more successful in showing the conditions of adolescent girls with idiopathic scoliosis. However, other studies are required to determine which questionnaire is the best for evaluating the effect of brace treatment on quality of life of individuals with AIS.

The results of this study did show that a negative, signifi-

### Table 4. Results of Multivariate Analysis of Variance.

| Variables                      | High stress (n=20) | Moderate stress (n=32) | F     | P value (PES)* |
|--------------------------------|--------------------|------------------------|-------|---------------|
|                                | Mean (SD)          | 95% CI                 | Mean (SD) | 95% CI       |       |
| Physical functioning BrQ       | 3.37 (0.77)        | 3.03-3.72              | 3.71 (0.76) | 3.44-3.99   | 2.41  |
| Emotional functioning BrQ      | 2.70 (0.56)        | 2.41-2.98              | 3.34 (0.66) | 3.12-3.56   | 12.97 |
| Vitality BrQ                   | 3.27 (0.65)        | 2.86-3.68              | 3.37 (1.03) | 3.05-3.69   | 0.14  |
| School activity BrQ            | 3.83 (1.11)        | 3.44-4.21              | 4.30 (0.65) | 3.99-4.60   | 3.66  |
| Bodily pain BrQ                | 3.24 (0.45)        | 3.04-3.44              | 3.27 (0.43) | 3.11-3.43   | 0.05  |
| Social functioning BrQ         | 2.91 (1.04)        | 2.52-3.29              | 3.79 (0.72) | 3.48-4.09   | 12.84 |
| Total BrQ                      | 63.98 (8.31)       | 59.66-68.30            | 71.18 (10.33) | 67.77-74.60 | 6.89  |
| Self-image SRS-22              | 2.72 (0.72)        | 2.41-3.02              | 3.03 (0.63) | 2.79-3.27   | 2.64  |
| Mental health SRS-22           | 3.34 (0.79)        | 2.98-3.66              | 3.70 (0.80) | 3.41-3.98   | 2.49  |
| Satisfaction SRS-22            | 3.20 (1.01)        | 2.80-3.59              | 3.65 (0.79) | 3.34-3.97   | 3.25  |
| Total SRS-22                   | 3.36 (0.50)        | 3.12-3.59              | 3.63 (0.53) | 3.45-3.82   | 3.36  |

*Standard deviation (SD); Confidence intervals (CI); Partial eta square (PES); Brace questionnaire (BrQ); Scoliosis Research Society-22 (SRS-22)

### Table 5. Results of the Independent Sample t Test Based on the Severity of the Scoliosis Curve.

| Variables                      | Cobb angle ≤30° (n=18) | Cobb angle >30° (n=34) | P value |
|--------------------------------|------------------------|------------------------|--------|
|                                | Mean±SD                | Mean±SD                |        |
| Brace questionnaire            |                        |                        |        |
| General health domain          | 3.16±0.87              | 3.22±0.96              | 0.84   |
| Physical functioning           | 3.61±0.76              | 3.57±0.79              | 0.87   |
| Emotional functioning          | 3.11±0.72              | 3.08±0.69              | 0.91   |
| Self-esteem and esthetics      | 3.41±1.11              | 3.25±1.07              | 0.60   |
| Vitality                       | 3.19±0.98              | 3.41±0.86              | 0.41   |
| School activity                | 4.38±0.74              | 3.98±0.92              | 0.11   |
| Bodily pain                    | 3.35±0.43              | 3.21±0.44              | 0.27   |
| Social functioning             | 3.53±0.82              | 3.40±1.01              | 0.63   |
| Total score                    | 69.45±10.87            | 67.86±9.88             | 0.59   |
| Bad Sobernheim Stress Questionnaire-Brace | 10.11±4.80 | 9.58±3.72 | 0.66   |
| Total score                    |                        |                        |        |
| Scoliosis Research Society-22  |                        |                        |        |
| Function/activity              | 3.95±0.58              | 3.62±0.73              | 0.10   |
| Pain domain                    | 4.18±0.87              | 3.85±0.91              | 0.20   |
| Self-image domain              | 2.86±0.61              | 2.93±0.72              | 0.73   |
| Mental health domain           | 3.70±0.80              | 3.48±0.81              | 0.37   |
| Satisfaction domain            | 3.38±0.77              | 3.52±0.97              | 0.60   |
| Total score                    | 3.62±0.58              | 3.48±0.51              | 0.39   |
| Trunk Appearance Perception Scale | 4±0.56               | 3.56±0.70              | 0.02   |

SD: standard deviation
Table 6. Results of the Independent Sample t Test Based on the Patients’ Age and Duration of Brace Treatment.

| Variables                        | Age ≤13 (n=28) | Age >13 (n=24) | P value | Duration of brace treatment ≤6 months (n=14) | Duration of brace treatment >6 months (n=38) | P value |
|----------------------------------|----------------|----------------|---------|---------------------------------------------|---------------------------------------------|---------|
|                                  | Mean±SD        | Mean±SD        |         |                                             |                                             |         |
| Brace questionnaire              |                |                |         |                                             |                                             |         |
| General health                   | 3.35±0.82      | 3.02±1.01      | 0.19    | 3.53±0.88                                  | 3.07±0.91                                  | 0.11    |
| Physical functioning             | 3.63±0.83      | 3.52±0.71      | 0.62    | 3.45±0.77                                  | 3.63±0.78                                  | 0.47    |
| Emotional functioning            | 3.20±0.72      | 2.96±0.65      | 0.21    | 3.01±0.71                                  | 3.12±0.69                                  | 0.61    |
| Self-esteem and esthetics        | 3.19±1.14      | 3.43±1.01      | 0.42    | 2.78±0.93                                  | 3.50±1.07                                  | 0.03    |
| Vitality                         | 3.50±0.96      | 3.14±0.81      | 0.16    | 3.35±1.02                                  | 3.32±0.87                                  | 0.92    |
| School activity                  | 4.34±0.85      | 3.86±0.85      | 0.04*   | 3.97±1.02                                  | 4.17±0.83                                  | 0.47    |
| Bodily pain                      | 3.34±0.41      | 3.16±0.45      | 0.14    | 3.13±0.50                                  | 3.30±0.40                                  | 0.20    |
| Social functioning               | 3.70±0.75      | 3.15±1.08      | 0.04*   | 3.57±0.91                                  | 3.40±0.97                                  | 0.59    |
| Total score                      | 70.74±9.32     | 65.70±10.60    | 0.07    | 67.08±9.27                                 | 68.90±10.53                                 | 0.57    |
| Bad Sobernheim Stress Questionnaire-Brace Scoliosis Research Society-22 | 10.35±4.13     | 9.08±4.00      | 0.26    | 10.07±4.66                                 | 9.65±3.91                                  | 0.75    |
| Function/activity                | 3.81±0.69      | 3.65±0.71      | 0.40    | 3.57±0.65                                  | 3.80±0.71                                  | 0.30    |
| Pain                             | 4.05±1.04      | 3.87±0.72      | 0.49    | 3.67±1.05                                  | 4.07±0.83                                  | 0.15    |
| Self-image                       | 3.12±0.61      | 2.66±0.68      | 0.01*   | 3.05±0.59                                  | 2.85±0.70                                  | 0.35    |
| Mental health                    | 3.62±0.69      | 3.48±0.93      | 0.53    | 3.42±0.76                                  | 3.61±0.83                                  | 0.47    |
| Satisfaction                     | 3.37±0.99      | 3.60±0.79      | 0.36    | 3.53±0.81                                  | 3.46±0.94                                  | 0.79    |
| Total                            | 3.59±0.53      | 3.45±0.53      | 0.34    | 3.45±0.57                                  | 3.56±0.52                                  | 0.52    |
| Trunk Appearance Perception Scale| 3.62±0.64      | 3.82±0.72      | 0.29    | 3.71±0.77                                  | 3.71±0.65                                  | 0.98    |

SD: standard deviation

cient relationship exists between the emotional functioning domain of the BrQ and compliance with brace treatment. This result seems to be consistent with previous research that found that brace treatment may affect the patient’s physical functioning, emotional functioning, and bodily pain. Therefore, those patients with higher brace compliance have a worse emotional function.

We found out that among all of the quality-of-life parameters, emotional and social functions were more affected by stress level than others. For adolescent girls with idiopathic scoliosis who are under brace treatment, the external appearance and body shape are important and can affect their social relationships. Adolescence is a critical period for psychosocial development, and treatment with a brace can cause different emotional distress and psychosocial reactions. However, the stressor effects of a brace may vary by its type. Weiss et al. conducted a study on 63 individuals with AIS to evaluate the effects of wearing a Chêneau Boston brace, a Wilmington jacket, a SpineCor brace, and a Chêneau light brace on stress level. They concluded that those who used a Chêneau light brace have lower stress. Climent and Sánchez also found out that brace type can affect the quality of life of adolescents with spinal deformities. They concluded that the negative effects of the Milwaukee brace are higher than those of the Charleston bending brace, the Boston brace, and the thoracolumbosacral orthosis (TLSO). In addition, Babaee et al. found out that the Milwaukee brace and TLSO equally reduce the quality of life of individuals with AIS and there is no significant difference between them.

In our study, all adolescent girls with idiopathic scoliosis wore a Milwaukee brace. We found out that 20 participants (38%) had high stress, which is lower than 66% reported by Misterska et al. In that study, they investigated the stress level and quality of life of 30 women with idiopathic scoliosis 23 years after their treatment with a Milwaukee brace. The authors found out that emotional distress due to wearing a Milwaukee brace is high. However, Noonan et al. and Danielson et al. reported that long-term follow-up of individuals with AIS who have been treated with a Milwaukee brace shows that their quality of life was normal and similar to untreated scoliosis patients.

It has been reported that curve severity and poor trunk appearance can have negative effects on quality of life of adolescents with spinal deformities. However, our findings showed that they are not effective on stress and quality of life. However, a bad perception of trunk deformity in patients with Cobb angles of >30° was significantly greater than those with a Cobb angle of <30° based on TAPS. Therefore, TAPS is more sensitive in showing perception of trunk deformity than the other questionnaires used in this study in showing the difference between patients with mild to moderate curve severity.

Previous studies have noted that the patients’ age and duration of brace treatment are the other factors affecting the quality-of-life parameters of individuals with AIS. Our findings indicated that the school activity and social functioning domains of BrQ and self-image score of SRS-22 were better for participants ≤13 years old than participants older than 13 years old. A possible explanation for these re-
sults may be the higher brace compliance in younger than older children. A study showed that brace compliance is higher in elementary school children than high school adolescents\(^9\). It stated that because menarche status and Risser singe are related factors of quality of life, they may affect compliance and quality-of-life parameters. Regarding duration of brace treatment, our findings revealed that patients who have worn a brace for less than six months achieved a poorer score in self-esteem than patients who have worn a brace for more than six months. This result is in accord with Babaee et al.’s study\(^9\), which showed that the early stage of wearing a brace may cause emotional distress and psychological reactions in adolescents with AIS, affecting their self-esteem. However, after the initial shock caused by wearing a brace, they adapt to it, and thus, the problems are reduced.

Bágo et al.\(^31\) conducted a study on patients with idiopathic scoliosis aged 10-40 years who had undergone surgery. They found a significant difference between the baseline preoperative TAPS and final postoperative TAPS scores. In the baseline, when the mean of the Cobb angle was 64\(^\circ\), the TAPS score was 2.56. This score had improved to 4.21 after surgery with an average Cobb angle of 26\(^\circ\). In our study, the TAPS score for patients with a Cobb angle of >30\(^\circ\) was 3.56, which was significantly different from the scores of patients with a Cobb angle of <30\(^\circ\). According to Bágo et al.\(^31\) (2018), the TAPS questionnaire has satisfactory responsiveness to surgical treatment of idiopathic scoliosis and it can discriminate between curves requiring spinal fusion (Cobb angle>45\(^\circ\)) and those requiring nonsurgical interventions (Cobb angle<45\(^\circ\)). In our study, we found out that TAPS can discriminate between patients with mild to moderate curve severities.

**Limitations**

We conducted this study only on adolescent girls with idiopathic scoliosis who were under a Milwaukee brace treatment. Therefore, external validity is limited to this group of patients because the experience and distress caused by wearing a brace might be different between boys and girls\(^9,34\). Because the experience and distress caused by wearing a brace might be different between boys and girls, another study is needed to investigate the effect of wearing a brace on the stress level and quality of life of adolescent boys with idiopathic scoliosis and to compare it with adolescent girls with idiopathic scoliosis. Moreover, in this study, compliance was assessed subjectively. In this method, the compliance rate depends on the patients or their parent’s estimation. A shortcoming of this method is that it may lead to overestimation of brace compliance\(^45\). Therefore, the reported results of this variable should be interpreted with caution. It is unfortunate that the study did not include other types of braces. Therefore, the external validity of this study is limited to individuals with AIS who were under a Milwaukee brace treatment. It is suggested that a study similar to ours should be carried out to evaluate the effect of lower profile braces, such as a Chêneau brace, on stress and quality-of-life parameters of adolescents with AIS.

**Conclusion**

Among the quality-of-life parameters, social and emotional functions are more affected by stress level in brace treatment of AIS. In addition, the severity of scoliosis has no effect on quality-of-life parameters, but it can lead to a worse perception of trunk appearance.

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- Study conception and design: Vahideh Moradi, Amir-Hossein Memari; data collection: Vahideh Moradi, Sanaz Nadernejad; analysis and interpretation of results: Vahideh Moradi, Amir-Hossein Memari, Marjan Saeedi; draft manuscript preparation: all authors. Supervision and critical review: Ramin Kordi, Amir-Hossein Memari. All authors reviewed the results and approved the final version of the manuscript.

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