Differences in deformity and bracing-related stress between rural and urban area patients with adolescent idiopathic scoliosis treated with a Cheneau brace

Ewa Misterska[1], Maciej Głowacki[1], Anna Ignyś-O'Byrne[2], Joanna Latuszewska[3],
Jacek Lewandowski[3], Iwona Ignyś[4], Hanna Krauss[5], Jacek Piątek[5,6]

[1] Department of Pediatric Orthopaedics, Poznan University of Medical Sciences, Poland
[2] Department of Radiology, J. Strus City Hospital, Poznan, Poland
[3] University School of Physical Education in Poznan, Chair of Motor System Rehabilitation, Department of Motor System Rehabilitation, Poznan, Poland
[4] Department of Paediatric Gastroenterology and Metabolic Diseases, Poznan University of Medical Sciences, Poland
[5] Department of Physiology, Poznan University of Medical Sciences, Poland
[6] Institute of Rural Health, Lublin, Poland

▌ **Abstract**

The aim of the study was to compare the difference in stress levels between adolescent female groups of patients from urban and rural areas who were treated conservatively with an idiopathic scoliosis. The study comprised 2 groups of patients, 34 from an urban and 30 from a rural area, with a minimum application of a Cheneau brace for 12 hours a day, for a minimum of 1 month. Two study groups completed the Polish version of both Bad Sobernheim Stress Questionnaire-Deformity and Bad Sobernheim Stress Questionnaire-Brace. Both groups of patients felt moderate stress connected with conservative treatment and low stress related to trunk deformation. No difference was observed in stress level related to body disfigurement and conservative treatment between the 2 groups of patients. In the rural group of patients, a correlation between the apical translation and stress related to deformity was observed. No significant differences were stated in stress levels and coping mechanisms between patients from rural and urban areas, treated conservatively due to idiopathic scoliosis. a A difference was observed, however, regarding the correlation connected with the apical translation and stress level.

▌ **Key-words**

BSSQ; stress; adolescent idiopathic scoliosis; brace treatment; socio-demographic factors

INTRODUCTION

The psychological aspects of scoliosis as a chronic disease, usually diagnosed in adolescence, often constitutes a source of stress, especially related to diagnosis and various treatment methods [1-6]. Scoliosis sufferers experience a sense of rejection by their peers and may feel stigmatised due to their scoliosis-related body disfigurement like rib hump, asymmetrical waist, shoulders or chest, which could be further magnified by the problems of adolescence [7].

A critical period regarding stress levels has been identified in the initiation of brace treatment [8-10]. Ugwonali et al. [11] and Matsunaga et al. [12] analyzed the negative effects of conservative treatment in as short an observation period as one month from the start of conservative treatment.

Wang et al. emphasized a number of factors influencing quality of life in adolescents with scoliosis, including the degree of deformity, implemented treatment method, culture and living environment [13]. They suggest that these factors may be especially important in oriental countries, such as China, where the development level varies between regions, including urban and rural populations [13]. Unfortunately, until now,

little attention has been paid to the relation between socio-demographic factors, such as race, income, medical insurance, place of residence, stress level, or the patients perception relating to trunk deformation, patients attitude toward brace treatment or satisfaction with the results of scoliosis treatment. It might be interesting to investigate whether socio-demographic factors related to living environments could influence the patients condition in other developing countries, such as Poland which, after the economic and political changes associated with the collapse of Communism, was brought to new Western standards of living and lifestyle.

It should be noted that in addition to the main lines of government policy towards the disabled, usually only implemented in some urban centres, one can not speak of a comprehensive policy from the public authorities in Poland for the disabled. The result is a dramatic difference in opportunities for disabled people depending on their place of residence, in particular for a significant number of people with disabilities living in rural areas and small towns [14]. A manifestation of this social problem is that in the consciousness of many people in Poland, a disabled child or youth is a cause for shame, and they should be concealed, which is not improving the social environment [14].

The disabled from rural environments, when compared with the disabled from the urban cohort of patients, are often socially excluded to a greater degree. Psychologically

411

Annals of Agricultural and Environmental Medicine 2011, Vol 18, No 2

Ewa Misterska, Maciej Głowacki, Anna Ignyś-O'Byrne, Joanna Latuszewska, Jacek Lewandowski, Iwona Ignyś, Hanna Krauss, Jacek Piątek. Differences in deformity…

this syndrome often manifests as social apathy, a feeling of helplessness, being withdrawn, and living in a closed home environment [14].

To date, the majority of researchers have investigated long-term outcomes related to scoliosis treatment. It has been indicated that adolescent scoliosis patients experience problems during bracing and need the health care professionals support. It has also been underlined that improvement of appearance resulting from surgical correction significantly increases post-treatment self-image and satisfaction [5, 15, 16].

The aim of the study was to compare the differences in deformity and bracing- related stress between rural and urban patients with adolescent idiopathic scoliosis treated conservatively.

Analyzed stress levels are related to trunk deformation and the use of an orthopaedic brace in patients treated conservatively, for a minimum treatment period of one month. Our attempts to assess the negative influence of conservative treatment on adolescent scoliosis patients living in different environments were carried out by using research tools that take into account specific requirements related to the necessity of wearing a brace, and stress related to body disfigurement.

MATERIALS AND METHODS

Structure of the study. The study group consisted of 64 patients with adolescent idiopathic scoliosis treated with a Cheneau brace by the same orthopedic surgeon in the Pediatric Orthopedics and Traumatology Clinic. The examined patients received in-depth information on the aim of the study, were guaranteed anonymity and written signed consent from their parents was received prior to inclusion in the study. All study participants were selected consecutively. Demographic variables and previous medical history were taken from all of the patients. The study group was divided into 2 subgroups: urban (n=34, 53.1%), and rural (n=30, 46.9%), based on the information provided in the questionnaire.

Eligibility criteria included: females with adolescent idiopathic scoliosis, age between 10-17 years, minimum duration of Cheneau brace application of 12 hours a day, a minimum treatment period of one month, Cobb angle of 20-40 degrees in thoracic, thoracolumbar or lumbar scoliosis. The analysis did not include patients suffering from other conditions leading to trunk deformity or other serious medical conditions.

23.5% (8 cases) of the urban patients attended primary school, 64.7% (22 cases) attended junior high school and 11.8% (4 cases) attended high school. 10% (3 cases) of the rural patients attended primary school, 60% (18 cases) attended junior high school and 30% (9 cases) attended high school. 34.3% (12 patients) from the urban cohort lived in a city with a population of 25,000, 42.85% (15 patients) lived in a city with a population between 25,000-200,000, and 22.85% (8 participants) lived in a city with more than 200,000 inhabitants.

Methodology of x-ray examination. X-ray images were taken in an upright position with the iliac ala exposed in an anterior-posterior projection. X-rays that were taken before application of the Cheneau braces were analysed. The following parameters were considered: Cobb angle in the main curve, distance between the apical vertebra of scoliosis and the central sacral vertical line (CSVL, in centimetres),

described as the degree of the apical translation of the CSVL. The location of the major deformation curve and curve (left/right) pattern were analysed.

Urban group of patients. Thoracic scoliosis was identified in 41.2 % of the patients, thoraco-lumbar scoliosis in 47%, and lumbar scoliosis in 11.8% of participants. Right curve pattern was observed in 58.8% patients and left curve pattern in 41.2%.

Rural group of patients. Thoracic scoliosis was identified in 60% patients, thoraco-lumbar scoliosis in 30%, and lumbar scoliosis in 10%. Right curve pattern was observed in 66.7% of cases and left curve pattern in 33.3%. The demographic and clinical characteristics of the patients from urban and rural populations is summarised in Table 1.

Table 1. Characteristics of study participants-patients from urban and rural areas

PARAMETERS	Urban population		Rural population	
	Mean (SD)	Range*	Mean (SD)	Range*
Weight [kg]	48.4 (8.4)	26-65	49.8 (6.7)	35-62
Height [cm]	163.4 (7.1)	142-180	162.7 (6.8)	148-175
Body Mass Index (BMI)	18.0 (2.0)	12.9-21.0	18.7 (1.8)	16.0-22.9
Age at assessment [years]	13.9 (1.56)	10-16	14.7 (1.49)	11-17
Age at initiation of treatment [years]	12.4 (2.2)	10-15	13.4 (1.96)	10-16
Brace [hours/day]	15.7 (3.2)	12-23	15.4 (2.94)	12-22
Brace [months]	17.5 (14.3)	1-58	16.0 (14.2)	1-54
Cobb angle	26.8 (5.6)	20-40	28.2 (4.3)	20-40
Apical translation [cm]**	1.72 (0.9)	0.3-3.7	2.2 (1.1)	0.4-5.2
Angle of trunk rotation***	6.86 (3.8)	1-17	6.87 (4.3)	1-20

* Range (min-max) for continuous data.
** Degree of apical translation of centre sacral vertical line (CSVL) according to the Harms Study Group.
*** Angle of trunk rotation as measured with Perdriolli's inclinometer.

No significant differences were observed between the urban and rural patient populations regarding age at the beginning of the treatment, weight, height, Body Mass Index, duration of brace wearing, Cobb angle of the main curve, apical translation, angle of trunk rotation, the location of the apical vertebrae, or the location of the major deformation curve (p>0.05). The two groups of patients differed significantly regarding age at the time of the assessment only (p=0.041).

MATERIALS AND METHODS

All patients who met the inclusion criteria completed the Bad Sobernheim Stress Questionnaire-Deformity (BSSQ-Deformity) and the Bad Sobernheim Stress Questionnaire-Brace (BSSQ-Brace) [17]. These relatively new assessment tools take into account specific requirements related to the conservative treatment and the stress related to body deformation resulting from adolescent idiopathic scoliosis. The Polish versions of the BSSQ-Brace and BSSQ-Deformity meet the criteria of excellent internal consistency and test-retest reliability [18].

BSSQ-Brace and BSSQ-Deformity have a very similar structure and each of them consists of 8 questions. BSSQ-Deformity relates to the effect of spine deformity on patients'

mood, interactions with the social environment and, as a result, the effect of experienced stress. BSSQ-Brace focuses on the psychological burden connected with the necessity of conservative treatment and assesses the influence of brace wearing on the patients mood, social interactions, and consequently on their stress level [17]. It is important to underline that these assessment tools can be used to measure the patients coping strategies and the impairment due to body disfigurement and the conservative treatment [17]. It might be interesting to evaluate if any differences exist in coping strategies between patients from different environments.

The answers on Bad Sobernheim Stress Questionnaires were marked on a four-point scale: from 0-3, and the general score ranges from 0-24. The interpretation based on the obtained results indicates the higher the score the lower the stress, thus 0 is interpreted as the greatest stress while 24 the least stress. Botens-Helmus et al. proposed the following interpretation: 0–8 (strong stress), 9–16 (moderate stress) and 17–24 (little stress) [17].

Ethical issues. The study was approved by the Bioethics Committee of Poznan University of Medical Sciences.

Statistics. For statistical quantitative variables we calculated the mean, a 95% confidence interval, range and standard deviation. For qualitative variables, we gave the number of units that belong to groups of described categories of a given feature respective percentages. As the majority of considered variables and results were not normally distributed, we used non-parametric tests to verify the hypothesis. To establish relationships between quantitative variables we used Spearman's rank correlation (marked as rS). The Mann-Whitney test was used to compare the 2 groups with respect to quantitative variables. The paired samples t-test was used. A level of statistical significance of p=0.05 was adopted; test results whose p value exceeded this were treated as not significant. Statistical calculations were performed using Statistica software.

RESULTS

The obtained BSSQ-Brace and BSSQ-Deformity results are summarized in Table 2. Patients residing both in urban and rural areas experienced a moderate stress level combined with conservative treatment, and low stress level related to perceived trunk deformation. These differences wee statistically significant in both subgroups: urban (p<0.001) and rural (p=0.002) environments. This indicates that brace wearing resulted in increased stress level when compared to the stress induced by the deformity alone (Table 2).

Table 2. BSSQ-Deformity and BSSQ-Brace results in urban and rural patient populations

Questionnaire	N	Min.	Max.	Mean	95% Confidence interval	
					from	to
Urban patient population						
BSSQ-Deformity	34	5	24	18.0	16.6	19,5
BSSQ-Brace	34	0	23	12.9	11.1	14.7
Rural patient population						
BSSQ-Deformity	30	7	24	17.0	15.0	18.9
BSSQ-Brace	30	1	22	12.3	10.6	14.1

Table 3 presents the interpretation of the results based on BSSQ-Brace and BSSQ-Deformity. Most patients from urban (70.5%) and rural (60.0%) areas experienced little stress related to body disfigurement. Only 1 patient residing in a town and 2 patients from a village experienced high stress because of perceived trunk deformity. The results are different in the case of BSSQ-Brace. Almost 60% of patients from the urban group and 66.7% of patients from the rural group experienced medium stress level. Only 29.4 and 16.6 % of patients reported little stress related to brace wearing, respectively (Table 3).

Table 3. Interpretation of BSSQ-Deformity and Brace results in urban and rural groups of patients

Questionnaire	Severe stress level		Medium stress level		Little stress level	
	n	%	n	%	n	%
Urban patient population						
BSSQ-Deformity	1	3.0	9	26.5	24	70.5
BSSQ-Brace	5	14.7	19	55.9	10	29.4
Rural patient population						
BSSQ-Deformity	2	6.7	10	33.3	18	60.0
BSSQ-Brace	5	16.7	20	66.7	5	16.6

We performed cross-group comparisons of BSSQ-Deformity and BSSQ-Brace results in urban and rural patients. The detailed analysis for both general and individual results was performed. It was stated that there is no difference regarding stress level as a result of the body disfigurement and the conservative treatment in the two groups of patients (p=0.478; p=0.705, respectively). Based on the detailed analyses of each individual item, it was indicated that both analyzed groups of patients did not differ significantly regarding the coping strategies used.

Analysis of the relationship between selected patients characteristics and the results of BSSQ-Brace and BSSQ-Deformity was performed, and the differences between both analysed subgroups of study participants were observed. A strong adverse correlation between the apical translation and stress level connected to body disfigurement (rs=-0.44, p=0.048) was observed only in the rural group of patients. However, it was noted in both analyzed patients subgroups treated conservatively with a Cheneau brace that there was no significant correlation between the value of the Cobb angle in the main curve, the length of time the brace was worn, age of the patient and stress levels (Table 4).

Table 4. Analysis of relationships between patients characteristics and BSSQ-Brace and BSSQ-Deformity results

Parameters	BSSQ-Deformity		BSSQ-Brace	
	Urban population	Rural population	Urban population	Rural population
Cobb's angle	rs=0.10 p=0.554	rs=-0.18 p=0.325	rs=-0.28 p=0.098	rs=0.08 p=0.659
Apical translation	rs=-0.20 p=0.242	rs=-0.44 p=0.048*	rs=-0.34 p=0.184	rs=-0.35 p=0.051
Brace [hours/a day]	rs=0.17 p=0.319	rs=-0.24 p=0.194	rs=0.09 p=0.597	rs=-0.23 p=0.207
Brace [months]	rs=0.07 p=0.680	rs=0.17 p=0.360	rs=-0.27 p=0.110	rs=-0.07 p=0.707

*p<0.05.

Annals of Agricultural and Environmental Medicine 2011, Vol 18, No 2

Ewa Misterska, Maciej Głowacki, Anna Ignyś-O'Byrne, Joanna Latuszewska, Jacek Lewandowski, Iwona Ignyś, Hanna Krauss, Jacek Piątek. Differences in deformity…

413

DISCUSSION

As mentioned before, many factors affect the condition of patients with adolescent idiopathic scoliosis, including treatment method, degree of deformity or living environment [13]. It was found that body deformities related to scoliosis, such as rib hump or decomposition of the trunk, are sources of stress and fear and disturb the development of body image [9]. Many authors emphasize that the necessity of wearing an orthopedic brace may cause the patient emotional distress [19]. They highlight the fear that patients have regarding using a brace in relation to their social life [10]. Our results in both analyzed group of patients confirmed the observations of Botens-Helmut et al. [17] and Kotwicki et al. [20] regarding higher stress levels due to brace application when compared to the stress related to trunk deformation alone. This suggests that patients experiencing stress related to body disfigurement often experience additional stress related to conservative treatment.

The patients' reactions in the early phase of brace application were especially significant for our study design. It was indicated that the first 2-6 weeks constitute the critical period regarding the intensity of stress level and applied coping mechanisms [8]. However, we did not find a clear association between the length of time the brace was worn and stress levels in patients from both urban and rural areas. It is suggested that in order to reduce emotional distress in patients treated conservatively and prevent their dropout from the therapy, it is essential not only to provide adequate information about the brace treatment to individual patients and parents, but also to detect emotional distress in patients as quickly as possible [12].

Psychological tests like BSSQ-Brace or BSSQ-Deformity may be very useful for providing a tool for modifying the brace therapy according to the psychological condition of individual patients [12].

It was noticed that other factors related to the treatment methods may negatively affect the condition of patients. We refer often to the results of Chinese publications due to the lack of occidental publications on psychosocial functioning of patients with idiopathic scoliosis treated conservatively.

Wang et al. suggest that socio-demographic factors may be especially important in developing countries such as China where the state of development varies between different regions, including urban and rural populations [13]. He hypothesized, as in our study, that the region of residence (rural *vs*. urban environment) could have an impact on the quality of life of adolescent scoliosis patients. Wang et al. found that the living environment influenced the postoperative results of SRS-22: the satisfaction score for domain management in the urban group was significantly higher compared to the rural group; however, the score on the self image/appearance in the urban group was significantly lower. At the same time, it should be underlined that there were no significant differences in function/activity, pain, or mental health domain between the 2 analyzed groups [13].

Similarly, Verma et al. evaluated the influence of variables related to demographic factors on the Scoliosis Research Society (SRS)-22 results in a healthy control population. He found that race, income, gender, and single *vs* dual-parent households significantly affected the individual domains and overall SRS-22 scores [21].

In our study, we assumed that factors related to living environments could also influence the emotional distress of patients in Poland, a country developing from Western culture. In the developing countries the economic situation is often imbalanced in different regions. When compared to rural areas, in urban regions the life-style may be relatively open, the income relatively high, and the quality of health care system of a relatively higher standard [14]. Considering possible differences in the condition of patients from different living areas, we should take into account the economic and political changes in Polish society after the collapse of Communism, which resulted in Western lifestyle standards being introduced to Poland.

It should be underlined that we did not confirm potential differences in stress levels related to body deformation and the necessity of wearing the brace between the study participants from urban and rural regions. Based on the detailed analyses of each individual question, we indicate that both patient subgroups do not differ significantly in using particular coping strategies. It seems that during the period of European integration, the past cultural differences between these 2 living environments gradually disappeared. The potential differences between rural and urban living areas seem to be more meaningful and evident in the Eastern rather than in the Western culture.

However, for future research, the following implications should be drawn from this study: examining the differences in patients' satisfaction with scoliosis treatment, activity, self-image or mental health, in subgroups residing in different environments treated with an orthopaedic brace. It could also be interesting to examine the stress levels in patients treated surgically as a different aspect to the socio-demographic factors.

CONCLUSION

We found that there were no significant differences in stress levels between patients from rural or urban areas with conservatively treated scoliosis. The analyzed subgroups of adolescents with scoliosis did not differ in particular coping strategies, beliefs, and the psychological burden related to body deformation and scoliosis treatment. The correlation related to the apical translation and the stress level was the only difference between the 2 analysed subgroups of patients.

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414   **Annals of Agricultural and Environmental Medicine 2011, Vol 18, No 2**

Ewa Misterska, Maciej Głowacki, Anna Ignyś-O'Byrne, Joanna Latuszewska, Jacek Lewandowski, Iwona Ignyś, Hanna Krauss, Jacek Piątek. Differences in deformity…

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