The Structure of Postural Disorders and Spinal Deformities in Age and Gender According to Computer Optical Topography

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Abstract: Since 1996 in Russia the screening of the child population is carried out using the diagnostic system TODP. The purpose of the study - to explore gender and age features of the postural formation. The most significant differences in the postural formation between boys and girls have been identified in the sagittal plane. A strong correlation between the development of structural scoliosis and growth of the body for both genders was revealed in the frontal plane.

1. Introduction

In Russia a TODP system on the basis of computer optical topography method (COMOT) was designed for school spinal deformity screening and was used as a pilot study in 1996. The experience has proved to be successful and today such screening is conducted on a regular basis in the framework of regional programs in many Russian cities. Thus, about 40,000 schoolchildren were examined during 2010-2011 academic year in Novosibirsk. At present, we have accumulated significant statistical data of screening results, analysis of which is presented in this paper and is first published in English.

2. Method and Material

The COMOT was developed in 1994 at Novosibirsk Research Institute of Traumatology and Orthopaedics based on a fringe projection method and phase spatial detection. This study uses the screening examination results of more than 33000 children and adolescents aged from 5 to 17 years, which were received from 2002 to 2010 years in a 6 Russian cities (near 5500 examination from each city), located between 53° and 58° northern latitude (Perm, Tolyatti, Omsk, Novosibirsk, Abakan, Tyumen). The examined population was divided into 13 age groups each including individuals of the same age (year ±6 months).

3. Result

The results of this study are shown for each plane separately in Fig. 1-3 in diagram forms and in Table 1.Notations of types and variants of postural disorders and spinal deformities used in these Figures and the Table are described in an accompanying paper in this volume, which deals with the classification of postural states according to computer optical topography.
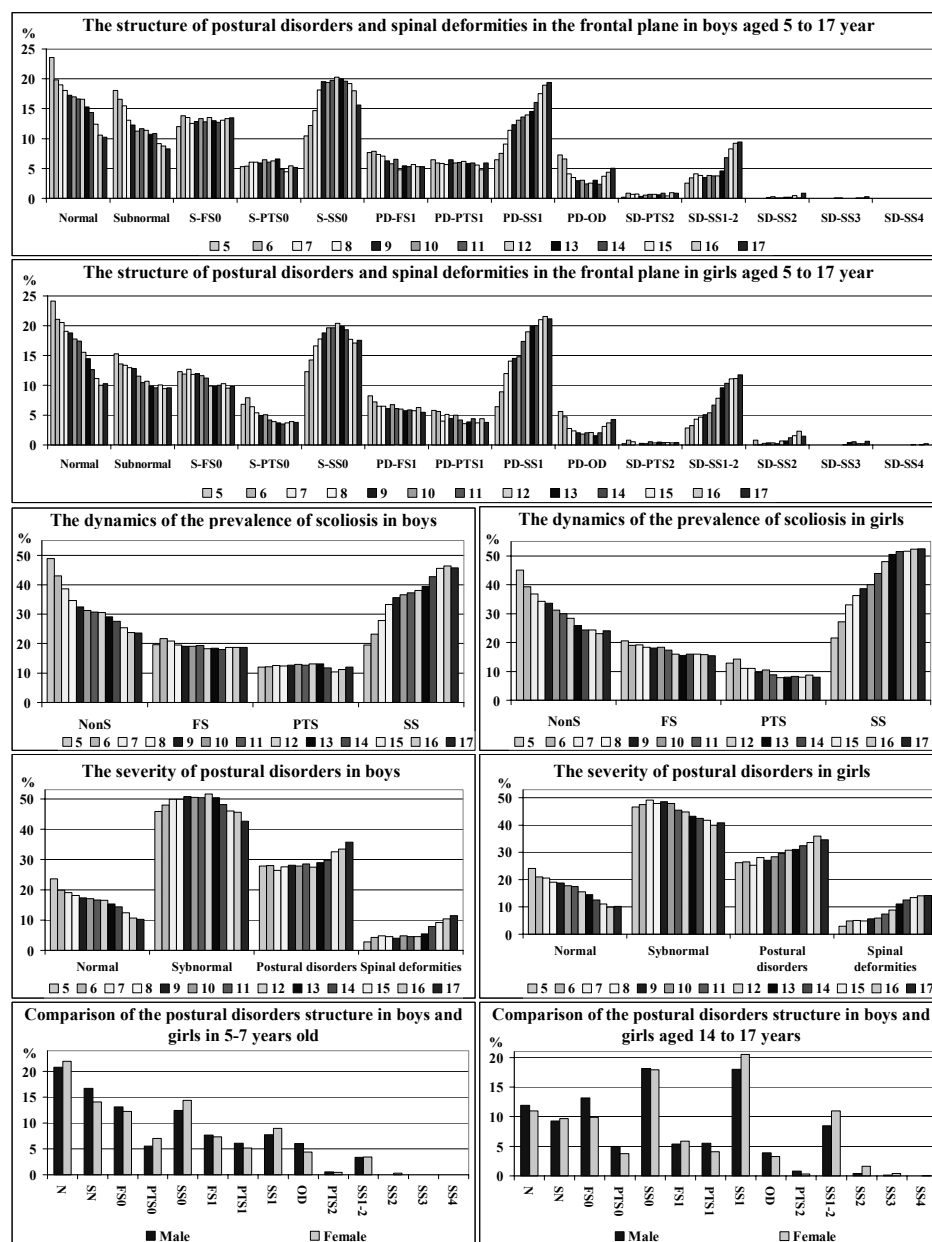

Figure 1. Gender and age structure of postural disorders and spinal deformities in the frontal plane.
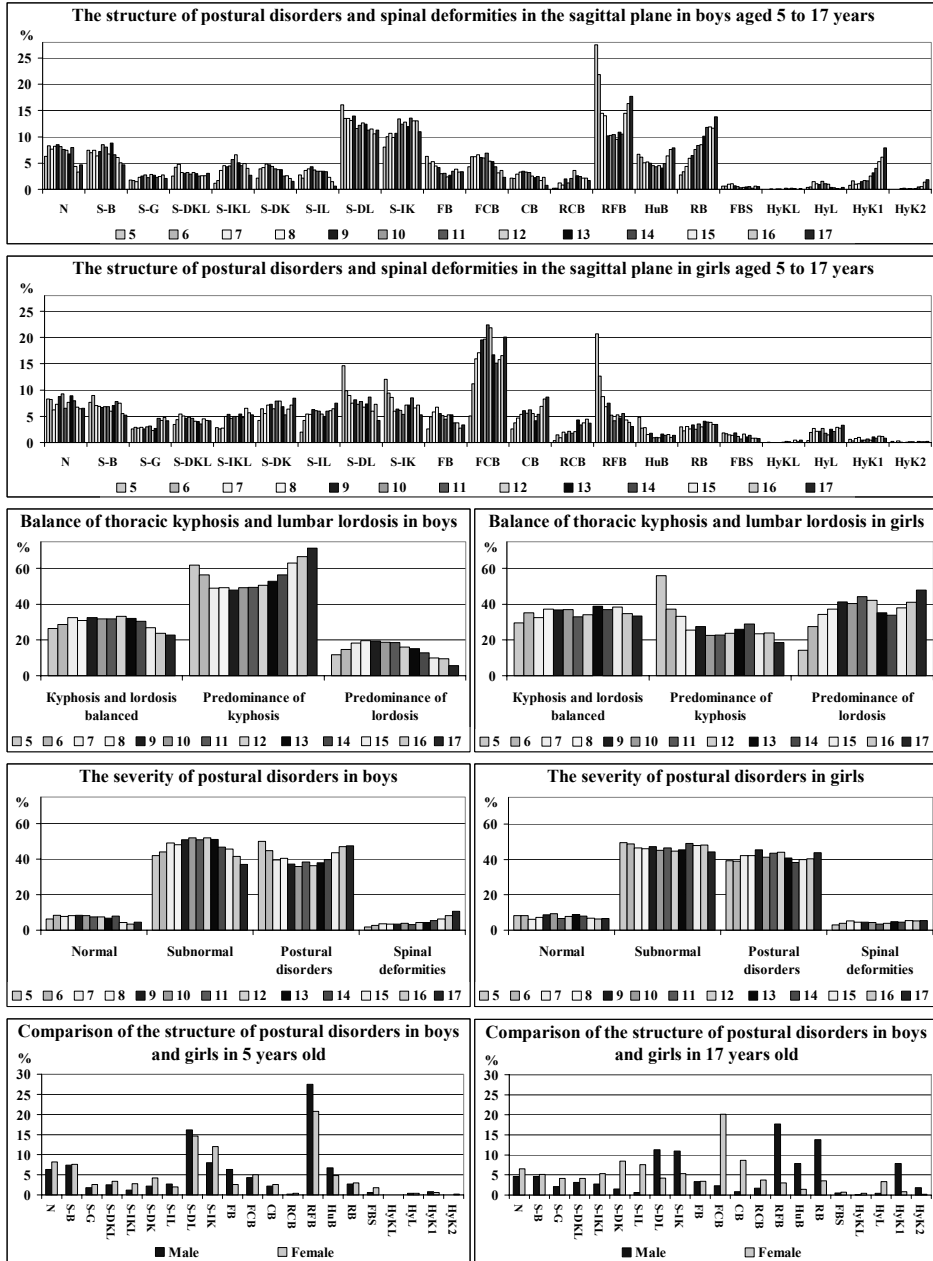
Figure 2. Gender and age structure of postural disorders and spinal deformities in the sagittal plane
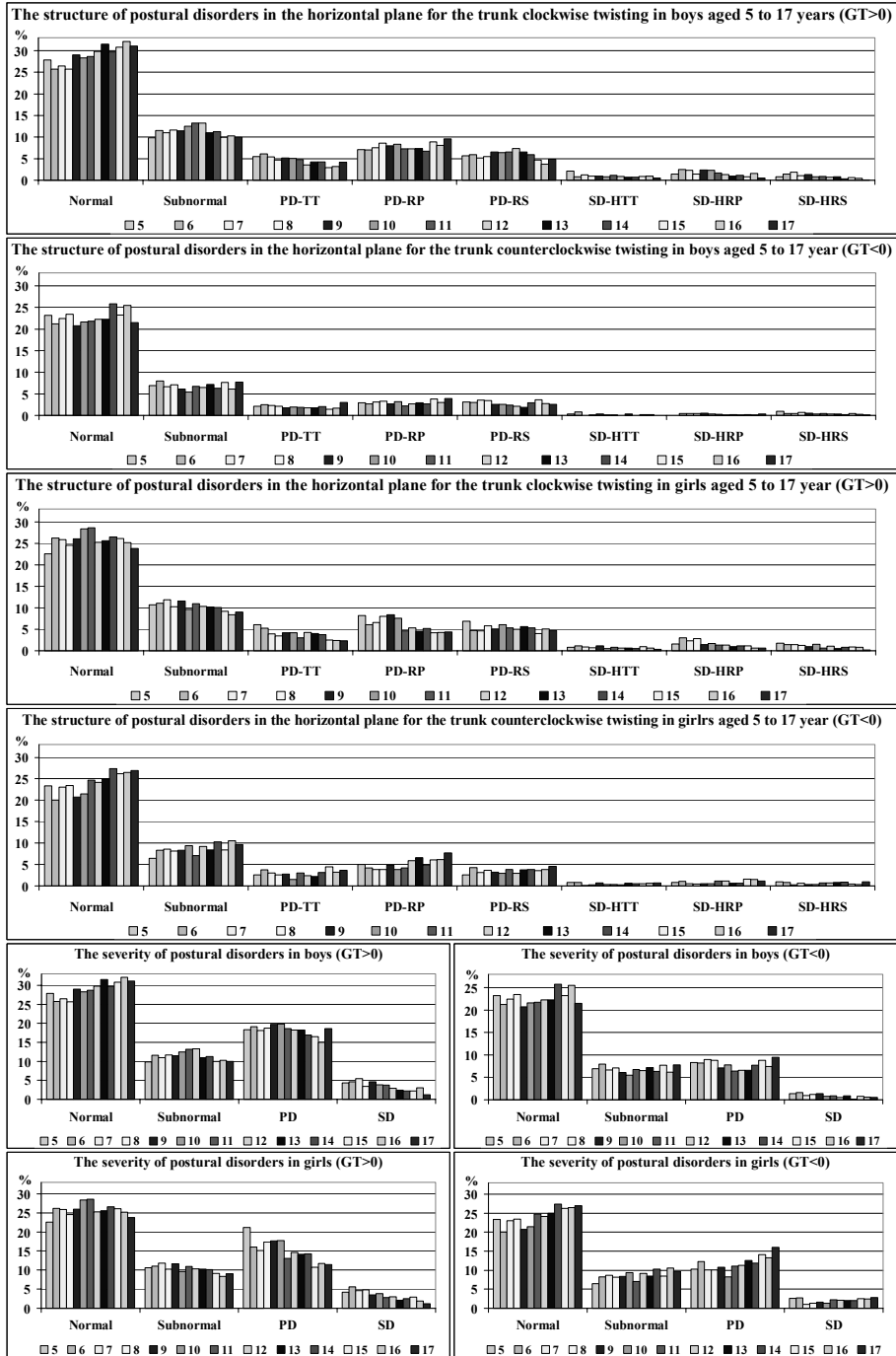
Figure 3. Gender and age structure of postural disorders and spinal deformities in the horizontal plane.

Table 1. Comparison of the structure of postural disorders in boys (M) and girls (F)

Notation	5 years			17 years			mean for 5-17 years		
	M,%	F,%	M/F	M,%	F,%	M/F	M,%	F,%	M/F
Frontal plane									
NonS	48.92	45.07	1.09	23.54	24.10	0.98	32.26	30.80	1.05
FS	19.65	20.52	0.96	18.76	15.33	1.22	19.26	17.34	1.11
PTS	11.98	12.88	0.93	12.03	8.03	1.50	12.24	9.77	1.25
SS	19.45	21.53	0.90	45.67	52.54	0.87	36.24	42.09	0.86
SS1	6.09	6.44	0.95	19.28	21.04	0.92	13.41	16.57	0.79
SS1-2	2.55	2.82	0.91	9.06	11.42	0.79	4.93	7.24	0.70
SS2	0	0	-	1.04	1.48	0.70	0.17	0.75	0.26
SS3+4	0	0	-	0.13	0.63	0.20	0.03	0.17	0.19
N	23.58	24.14	0.98	10.22	10.25	1.00	16.22	16.37	0.99
S	45.78	46.68	0.98	42.56	40.80	1.04	48.37	45.12	1.07
PD	27.90	26.16	1.07	35.71	34.67	1.03	29.37	29.97	0.98
SD	2.75	3.02	0.91	11.52	14.27	0.81	6.05	8.54	0.71
Sagittal plane									
BKL	26.33	29.58	0.89	22.90	33.51	0.68	29.58	35.26	0.84
PK	61.89	56.14	1.10	71.41	18.50	3.86	55.74	28.45	1.96
PL	11.79	14.29	0.83	5.69	47.99	0.12	14.68	36.74	0.40
N	6.29	8.25	0.76	4.66	6.55	0.71	6.87	7.60	0.90
S	42.04	49.50	0.85	37.00	44.19	0.84	47.01	46.83	1.00
PD	49.90	39.24	1.27	47.61	43.76	1.09	41.44	41.53	1.00
SD	1.8	3.0	0.59	10.7	5.5	1.95	4.68	4.49	1.04
FB	6.29	2.62	2.40	3.36	3.38	0.99	3.85	4.58	0.84
FCB	4.32	5.03	0.86	2.33	20.08	0.12	5.11	16.69	0.31
CB	2.16	2.62	0.83	0.78	8.67	0.09	2.50	5.64	0.44
RCB	0.20	0.40	0.49	1.68	3.70	0.45	1.73	2.46	0.70
RFB	27.50	20.72	1.33	17.72	3.07	5.78	14.49	7.12	2.03
HuB	6.68	4.83	1.38	7.89	1.37	5.74	5.55	1.81	3.08
RB	2.75	3.02	0.91	13.84	3.49	3.97	8.21	3.23	2.54
FBS	0.59	1.81	0.33	0.52	0.74	0.70	0.59	1.27	0.46
HyKL	0.00	0.00	-	0.13	0.42	0.31	0.08	0.12	0.68
HyL	0.39	0.40	0.98	0.39	3.28	0.12	0.70	2.22	0.32
HyK1	0.79	0.60	1.30	7.89	0.85	9.33	2.94	0.76	3.87
HyK2	0.00	0.20	-	1.81	0.21	8.57	0.38	0.12	3.08
Horizontal plane (clockwise twisting of trunk, GT>0)									
N	27.90	22.54	1.24	31.05	23.78	1.31	28.97	25.74	1.13
S	9.82	10.66	0.92	9.96	8.99	1.11	11.30	10.24	1.10
PD	18.27	21.13	0.86	18.63	1.42	1.63	18.13	15.01	1.21
SD	4.32	4.23	1.02	1.16	1.16	1.00	3.38	3.31	1.02
TT	7.66	6.84	1.12	4.66	2.64	1.76	5.52	4.55	1.13
RP	8.45	9.86	0.86	10.09	4.97	2.03	9.36	7.50	1.10
RS	6.48	8.65	0.75	5.05	4.97	1.02	6.62	6.27	1.21
Horizontal plane (counter clockwise twisting of trunk, GT<0)									
N	23.18	23.34	0.99	21.47	26.96	0.80	22.70	24.07	0.94
S	6.88	6.44	1.07	7.76	9.62	0.81	6.80	8.68	0.78
PD	8.25	10.26	0.80	9.44	15.96	0.59	7.84	11.68	0.67
SD	1.38	2.62	0.53	0.52	2.85	0.18	0.88	2.05	0.43
TT	2.55	3.42	0.75	2.98	4.44	0.67	2.20	3.46	0.64
RP	2.95	5.84	0.51	4.27	8.88	0.48	3.28	6.07	0.54
RS	4.13	3.62	1.14	2.72	5.50	0.49	3.25	4.19	0.78
Horizontal plane (ratio for the GT>0 and GT<0)									

	N	S	PD	SD	TT	RP	RS
M (5 years)	1.20	1.43	2.55	2.40	3.00	2.87	1.57
F (5 years)	0.97	1.66	2.31	1.64	2.00	1.69	2.39
M (17 years)	1.45	1.28	1.39	2.47	1.57	2.36	1.86
F (17 years)	0.88	0.93	0.63	0.56	0.60	0.56	0.90

4. Discussion

In the frontal plane the structure of postural disorders in boys and girls at the age of 5 and 17 years differs only quantitatively. A common dynamics of age changes in structure of postural disorders in both genders is revealed: decrease in a number of cases without scoliosis (NonS) from 48.9% to 23.5% in boys and from 45.2% to 24.1% in girls, and growth of structural scoliosis from 19.5% to 45.7% and from 21.5% to 52.5% respectively. We have found a strong positive correlation between the frequency of structural scoliosis and the average body length same for boys and girls (0.93 and 0.92 respectively), and have confirmed the fact that the progression of structural scoliosis is strongly associated with the period of puberty. Functional scoliosis (FS) has a general tendency to decrease with age. However, in boys, it is much less pronounced than in girls: the percentage of FS in boys decreases from 19.7% in 5 years to 18.8% in 17 years, and in girls - from 20.5% to 15.3% respectively. Compensatory scoliosis (PTS) behaves differently: its percentage in boys remains unchanged (11.98% and 12.03%), and is reduced in girls from 12.9 % to 8.0 %.

In the sagittal plane the structure of postural disorders in boys and girls at the age of 5 years differs only slightly. More frequently both genders have posture with predominance of kyphosis (PK) (61.9% in boys and 56.1% in girls), which often occurs due to flattening of lordosis. Also both genders are much more likely to have round flat back (RFB) with normal kyphosis and flattened lordosis (27.5% and 20.7% respectively). Starting at 5 years gender difference in posture structure dynamics is observed: simple in boys and more complex in girls (Fig.2). Such dynamics result in achieving a maximum gender differences by the age of 17 years with prevalence of PK in boys and PL in girls. Round flat back is more likely to occur in boys (14.5%, 3.2 times more frequent than in girls), and flat concave back (FCB) – in girls (16.7%, 3.3 times more frequent than in boys).

In the horizontal plane the structure of postural disorders and its dynamics in boys and girls (without taking into account the trunk twisting direction) coincide qualitatively and only slightly differ quantitatively. When direction of twist is taken into account age gender differences are revealed. At the age of 5 years the trunk twisting in a clockwise direction prevails both in boys and girls regardless the variety of posture. At the age of 17 years the prevalence of clockwise twisting is preserved in boys, but in girls counterclockwise twisting becomes prevailing regardless of posture variety (Table.1). This phenomenon is first identified and requires further investigations since its reason is not yet clear.

5. Conclusion

This research provides new and objective information on formation of posture in children and adolescents and the natural history of scoliosis. It proves the effectiveness of population-based studies using the topography. In Russia the use of computer optical topography for screening of children and adolescents will be expanded and we hope that in future every Russian child will receive such examinations each year.

Additional materials about COMOT in Russian are available on our website
http://www.metos.org/article_prim.php