



## Comparison of Body Posture Features in the Sagittal Plane in Obese and Non-Obese Girls At School age

### KEYWORDS

photogrammetric method Moire'a, body posture, sagittal plane, obese girls, non-obese girls.

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**ABSTRACT** The aim of the study was to compare the characteristics of body posture (BP) in the sagittal plane (SP) in obese and non-obese girls of school age. The study included 200 girls aged of 13-16 years attending junior secondary schools in Żywiec region. We separated obese and non-obese girls. The posture has been studied with the help of photogrammetric method of Moire (PMM), which included 8 parameters in the SP. To evaluate the differences between the characteristics of BP of obese and non-obese girls we used the test of Mann-Whitney U. In the individual rankings, we took the value of the coefficient Z and the assumed level of statistical significance of  $p < 0.05$ . The obese girls show a worse BP in SP than the non-obese girls. There was a significant difference between the BP ( $p < 0.05$ ) in obese and non-obese girls.

### Introduction

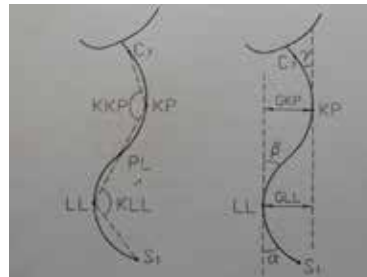
BP is an individual human trait, it is highly variable – especially in people during their progressive development. Obesity causes deterioration of BP and renal organ system in children. It is essential to early diagnosis of BP in children, making it possible to take effective action to prevent the consolidation of therapeutic non-normal BP at the age of adulthood. BP studies mostly focused on the detection of idiopathic scoliosis using photogrammetric Moire or by ISIS – Integrated Shape Imaging System.<sup>1,2,3,4,5,6,7,8</sup> Looking through the databases – Medline, PubMed, Science Direct, Springer Link, Wiley Online Library we found out the lack of comparative studies of BP in SP at obese children and non-obese ones.

### Objective

The aim of the study was to compare the characteristics of BP in SP obese and

### Methods

The study carried in May-June 2014 included 200 girls (50 in each age group) aged 13-16 from Żywiec region. The average age of the girls was  $14.5 \pm 1.1$ . We separated 36 obese girls, with a body mass index (BMI) in each age category of  $\geq 2SD$ . The average weight, body height and BMI in obese girls was  $59.5 \pm 3.3$ ;  $156.2 \pm 3.8$ ;  $24.18 \pm 1.27$ , while in non-obese ones –  $51.0 \pm 3.2$ ;  $162.3 \pm 4.0$ ;  $19.38 \pm 0.86$ . The differences between somatic groups were statistically significant,  $p < 0.05$ . BP has been studied with PMM, which included 8 parameters in SP – inclination angle of the trunk (KPT), inclination angle of the superior thoracic section of the spine (Gamma  $\gamma$ ), inclination angle of the thoraco-lumbar section of the spine (Beta  $\beta$ ), inclination angle of the lumbosacral spine (Alfa  $\alpha$ ), thoracic kyphosis angle:  $KKP = 180 - (\beta + \gamma)$ , lumbar lordosis angle:  $KLL = 180 - (\alpha + \beta)$ , depth of thoracic kyphosis (GKP), depth of lumbar lordosis (GLL) (Figure 1).



**Figure 1. The parameter evaluated according to the photogrammetric Moire method (PMM)**

All the parents were informed about the objectives, safety and the way to perform the tests. All the parents gave their consent for their children to participate in the research. To evaluate the differences between the characteristics of BP in obese and non-obese girls we used the test of Mann-Whitney U. In the individual rankings, we took the value of the coefficient Z and the assumed level of statistical significance of  $p < 0.05$ . The calculations were performed in the Department of Computer Science of Holy Cross Cancer Center in Kielce MedCalc software – version 11.4.3.0, licensed for Holy Cross Cancer Center.

### Results

There was a significant intergroup differences in the characteristics of BP in SP at the level of statistical significance  $p < 0.05$ . KPT of the obese girls was 3.7, whereas in the non-obese ones it was 2.0 ( $p = 0.000$ ). Gamma parameter  $\gamma$  of the obese girls was 12.7, while it was 9.9 in non-obese ( $p = 0.000$ ). The obese girls exceeded the non-obese girls in terms of the parameters Beta  $\beta$ , Alpha  $\alpha$ , – the corresponding values were: 11.6 and 9.5; 11.9 and 10.9 ( $p = 0.000$ ). KKP of the obese girls was 160.1, while it was 157.9 of the non-obese girls ( $p = 0.000$ ), and KLL was respectively 163.5 and 159.3 ( $p = 0.000$ ). GKP was 12.6 of the obese girl, of the non-obese it was 10.8 ( $p = 0.000$ ), GLL of the obese girls was 18.4, whereas of the non-obese ones it was 15.3 ( $p = 0.000$ ). The results show that obese girls have a worse BP than non-obese girls (Table 1).

**Table 1. The Characteristics of BP in the SP in obese and non-obese girls**

Variable	Obese girls (n =36)		Non-obese girls (n =164)		Z-value p-value
	mean ± SD		mean ± SD		
Inclination angle of the trunk – KPT (°)	3.7	0.8	2.3	1.4	5.664* 0.000
Inclination angle of the superior thoracic section of the spine – Gamma $\gamma$ (°)	12.7	2.3	9.9	1.9	5.566* 0.000
Inclination angle of the thoraco-lumbar section of the spine – Beta $\beta$ (°)	11.6	1.4	9.5	1.1	5.578* 0.000
Inclination angle of the lumbosacral spine – Alfa $\alpha$ (°)	11.9	1.3	10.9	1.2	4.553* 0.000
Thoracic kyphosis angle – KKP (°)	160.1	2.4	157.9	2.3	4.040* 0.000
Lumbar lordosis angle – KLL (°)	163.5	2.3	159.3	1.5	7.244* 0.000
Depth of thoracic kyphosis – GKP (mm)	12.6	2.3	10.8	1.6	3.879* 0.000
Depth of lumbar lordosis – GLL (mm)	18.4	1.9	15.3	2.1	6.044* 0.000

**Table 1. About here**

## Discussion

In the literature there are reliable comparative data BP of obese children in relation to non-obese children. Some authors tried to take this issue, but there is still a great need for further research that could expand our knowledge about this subject. Mrozkowiak<sup>9</sup> noticed that greater KPT, KKP, and the larger angle Beta  $\beta$ , more GKP are promoted

by greater BMI and excessive weight. Lizis et al.<sup>10</sup> pointed out that at obese people with increasing body mass, BP is deteriorated. Cieplik et al.<sup>11</sup>, Pawlicka-Lisowska et al.<sup>12</sup>, Barańska et al.<sup>13</sup> and Perez et al.<sup>14</sup> demonstrated that overweight children have an enlarged chest kyphosis and lumbar lordosis in comparison with healthy children. Our study confirms the results of other authors, we found out that obese girls have a greater anterior-posterior curvature of the spine than non-obese girls. The results demonstrate that obesity increases the anterior-posterior curvature of the spine, which is accompanied by a lesser BP. Evaluation of BP by PMM allows for the accurate spatial reflection of the actual size of the anterior-posterior curvatures of the spine. The results may be helpful in accurate diagnosis of BP in SP in obese children.

## Conclusions

The differences of BP in SP between obese and non-obese girls are significant ( $p < 0.05$ ). Obese girls have deepened anterior-posterior curvature of the spine, which marks the BP worse than in non-obese girls. That is why, a very important element to reach normal BP in obese children is prevention, including corrective exercises and shaping reflex of the normal BP. In addition, diet and increased physical activity should create the conditions for formation of normal BP in obese children.

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