

# The impact of age on female body posture

## Wpływ wieku na postawę ciała kobiet

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### Summary

**Introduction and aim of the study:** The body posture, which is one of the determinants of health and functional efficiency, changes depending on gender, age and psychophysical condition. Defining a pattern of correct posture is extremely difficult as it is a highly individualized feature. The aim of this paper was to compare the body posture of women in three periods of ontogenesis: girls in puberty, young adult women and women in the geriatric age.

**Material and methods:** 150 females were examined: 50 12-year-old pupils, 50 20–22-year-old students and 50 women aged 60–84. Their height and weight were measured, BMI calculated and the status of body weight determined as normal, overweight or obese. The Zebris Pointer ultrasound system analyzed the position of the spine in the sagittal and frontal plane, the symmetry of the shoulders and pelvis in the frontal plane, and the balance of the torso in the sagittal and frontal plane. The results were developed with the Statistica program. Basic descriptive statistics, contingency tables, Shapiro-Wilk test (study of normality of distribution) and Kruskal-Wallis test (inter-group comparison) were used. Differences between groups were assumed to be significant when  $p < 0.05$ .

**Results:** Age significantly differentiated the BMI index of the surveyed females. Overweight and obesity was more prevalent in the oldest age group. The size of thoracic kyphosis expressed in degrees was similar in all of the surveyed females, although hypokyphosis was observed more frequently among the female pupils and hyperkyphosis among the female students. Lumbar lordosis was significantly higher among the students when compared to the other groups. Hypolordosis was most common among the seniors. The students and seniors also differed in terms of the balance of the torso in the sagittal plane. Excessive backward inclination was diagnosed in 42% of the students (total backward shift of the centre of gravity of the human body), which was twice as rare among the female students and four times as rare among the seniors. Asymmetric position of the right and left shoulder and hip girdles was common in every group of the females surveyed. Side bendings of the spine were most often observed among the female pupils, and least frequently among the seniors. Left-sided bendings were more frequent than right-sided ones.

**Conclusions:** The age of women affects the position of the torso more in the sagittal plane than in the frontal one. The size of lumbar lordosis is an element of the body posture most significantly differentiating females between 12 and 84 years of age. Hyperlordosis is more characteristic of young adult women, whereas hypolordosis of seniors. Hyperkyphosis is most common in female students while hypokyphosis in adolescent girls.

**Key words:** body posture, females, bad posture

### Introduction

The issue of the correct posture of the human body is very complex. Determining the pattern of a correct posture is undoubtedly not easy, and the concept itself is difficult to define. Body posture is an individual feature, expressed in the model of a person's figure and dependent on many factors, such as the psychophysical condition, somatic structure, socio-economic con-

ditions, physical activity undertaken or the type of professional work [1, 2]. Body posture changes in the subsequent periods of ontogenesis, but at every stage of life it is one of the determinants of health and functional efficiency. In the individual development of the human body posture there are periods of relative stability and instability in its formation, which does not change the fact that the problem of bad posture is common in every age group. Due to the high dynamics of morphological and functional changes, the particularly critical period for posture formation is that of puberty, which for girls, with significant inter-individual variability, begins between 11 and 12 years of age and lasts

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for about five years [3, 4]. Numerous analyzes of puberty-related body posture can be found in the literature. Young adults are less frequently examined although in this age group the risk of bad posture is high, due to, among other things, improper lifestyle. The ageing process is associated with many structural and functional changes which also affect the body posture [2, 5–7]. However, despite growing interest in old age, there are still too few publications on issues related to changes in the body posture in people over 60 years of age. It is important to realize that even minor dysfunctions within the musculoskeletal system, which are left undiagnosed and neglected, may deepen in the future, leading to serious disorders and deterioration of the quality of life.

This paper is an attempt to answer the question about the most characteristic features of female body posture in three periods of ontogenesis: girls in puberty, young adult women and women in geriatric age. This analysis was to indicate the direction of changes in body posture among women and provide practical guidance for physiotherapists.

## Material and methods

The study involved 150 women from three age groups: 50 female pupils aged 12, 50 female students of physiotherapy and nursing aged 20–22 (20.72 + 0.72), 50 seniors aged 60–84 (69.18 ± 6.57). All of the females were volunteers. The height and body mass of the females under examination were measured using the calibrated anthropometer and TANITA weight. The BMI index was calculated and the body mass status of the females surveyed was determined. In the case of the female pupils, the BMI standards for children published by Cole and Bellizzi were used [8].

Selected parameters describing the torso position and the shape of the spine in the sagittal and frontal planes in the habitual standing position were estimated using the Zebris pointer ultrasound system to assess the posture. The examination

was conducted by an experienced therapist, the subjects were only wearing underwear. The measurements were carried out in the morning hours, the conditions being the same for all the females examined. All the women agreed to participate in the study and were informed about its results. The collected data were analyzed with the Statistica v10 program. Basic descriptive characteristics were used, contingency tables prepared and the significance of intergroup differences examined using the Kruskal-Wallis test, assuming the significance level  $\alpha = 0.05$ .

## Results

The level of basic somatic features significantly differentiated the women from the groups under examination. The height of the body was the highest among the female students, who were 9.1 cm higher than the seniors and 14.5 cm higher than the female pupils. The greatest body mass was reported among the seniors. They were 10.77 kg heavier than the students and 24.91 kg heavier than the pupils. BMI also had the highest level among the seniors. The value of this indicator was 6.88 kg/m<sup>2</sup> lower among the female students and 8.72 kg/m<sup>2</sup> lower among the female pupils (Table 1).

The correct body mass was observed among all the students, 38 pupils (76%) and 8 seniors (16%). 9 pupils (18%) and 25 seniors (50%), were diagnosed as being overweight. 3 pupils (6%) and 17 seniors (34%) were found to be obese.

The females examined did not significantly differ in the size of thoracic kyphosis, whereas lumbar lordosis was significantly more pronounced among the students than among the pupils and seniors (Table 2). Trunk inclination in the sagittal plane was significantly different among the female students and the seniors. Other variables did not significantly differentiate the groups under examination.

A qualitative analysis of the body posture showed that the most common thoracic hyperkyphosis occurred among the

**Table 1.**

The level of basic somatic features in the groups under examination (Kruskal-Wallis test, differences being significant for  $p < 0.005$ )

Variable	Group	Mean	Median	Minimum	Maximum	St. Dev.	p
Body height	Pupils	153.22	154.05	131.80	166.30	8.30	P & St $p < 0.0001^*$
	Students	167.72	166.00	161.00	179.00	5.52	St & Se $p < 0.0001^*$
	Seniors	158.62	158.00	149.00	178.00	6.22	P & Se $p = 0.3^*$
Body weight	Pupils	46.42	46.00	25.00	73.20	10.24	P & St $p < 0.0001^*$
	Students	60.56	58.00	45.00	75.00	7.47	St & Se $p < 0.0001^*$
	Seniors	71.33	70.85	56.80	92.00	9.51	P & Se $p < 0.0001^*$
BMI	Pupils	19.62	19.22	13.96	29.32	3.40	P & St $p = 0.02^*$
	Students	21.46	21.30	16.33	24.44	1.67	St & Se $p < 0.0001^*$
	Seniors	28.34	27.71	22.75	37.32	3.39	P & Se $p < 0.0001^*$

\*statistically significant difference (P – pupils; St – students; Se – seniors)

**Table 2.**

Differentiation of parameters describing the body posture among women from the groups under study  
(Kruskal-Wallis test, differences being significant for  $p < 0.005$ )

Variable	Group	Mean	Median	Minimum	Maximum	St. Dev.	p
Thoracic kyphosis [°]	Pupils	42.22	41.05	24.30	67.10	10.71	P & St $p=0.08$
	Students	46.93	50.50	29.80	61.40	9.86	St & Se $p=0.99$
	Seniors	46.88	45.10	14.90	70.00	13.64	P & Se $p=0.98$
Lumbar lordosis [°]	Pupils	27.71	28.55	3.00	50.00	10.23	P & St $p=0.006^*$
	Students	34.06	34.30	3.50	51.00	11.31	St & Se $p=0.001^*$
	Seniors	26.98	25.65	4.30	50.00	10.11	P & Se $p=0.98$
Trunk inclination in the sagittal plane [°]	Pupils	3.55	3.15	0.20	12.30	2.53	P & St $p=0.56$
	Students	2.82	1.90	0.20	6.20	2.10	St & Se $p=0.002^*$
	Seniors	4.85	4.05	0.20	15.80	3.18	P & Se $p=0.14$
Pelvic tilt [°]	Pupils	6.91	4.95	0.40	29.80	6.26	P & St $p=0.98$
	Students	8.04	5.60	0.40	25.50	6.74	St & Se $p=0.99$
	Seniors	8.96	7.55	0.00	26.30	7.58	P & Se $p=0.98$
Shoulders tilt [°]	Pupils	8.86	6.75	0.10	33.90	7.73	P & St $p=0.99$
	Students	8.47	7.70	0.30	19.10	5.67	St & Se $p=0.99$
	Seniors	9.08	7.30	0.30	27.90	7.01	P & Se $p=0.99$
Trunk inclination in the frontal plane [°]	Pupils	1.24	0.85	0.00	4.00	1.01	P & St $p=0.99$
	Students	1.32	0.90	0.10	3.90	1.05	St & Se $p=0.99$
	Seniors	1.47	1.05	0.00	8.70	1.46	P & Se $p=0.99$
Side bending of the spine [°]	Pupils	3.57	0.00	0.00	27.30	6.19	P & St $p=0.98$
	Students	2.24	0.00	0.00	15.00	4.38	St & Se $p=0.51$
	Seniors	0.71	0.00	0.00	13.00	2.56	P & Se $p=0.09$

\*statistically significant difference (P – pupils; St – students; Se – seniors)

**Table 3.**

Torso-body position in the sagittal plane in the groups under examination

	Thoracic kyphosis [°]		
	normal	hyperkyphosis	hypokyphosis
<b>Pupils</b>	n=17 34%	n=22 44%	n=11 22%
<b>Students</b>	n=8 16%	n=34 68%	n=8 16%
<b>Seniors</b>	n=19 38%	n=25 50%	n=6 12%
	Lumbarlordosis [°]		
	normal	hyperlordosis	hypolordosis
<b>Pupils</b>	n=12 24%	n=26 52%	n=12 24%
<b>Students</b>	n=6 12%	n=38 76%	n=6 12%
<b>Seniors</b>	n=14 28%	n=21 42%	n=15 30%
	Trunk inclination in the sagittal plane [°]		
	normal	backward	forward
<b>Pupils</b>	n=28 56%	n=21 42%	n=1 2%
<b>Students</b>	n=40 80%	n=10 20%	n=0 0%
<b>Seniors</b>	n=41 82%	n=6 12%	n=3 6%

female students, and that hypokyphosis was characteristic of the female pupils. Hyperlordosis was also most often observed among the female students, while hypolordosis among the seniors. The vast majority of the female students and seniors had a correct sagittal trunk inclination. Among the pupils, a higher incidence of backward inclination of their body axes towards the rear was more frequent (Table 3).

A perfectly symmetrical position of the right and left sides of the pelvis was observed only in one woman, from the oldest age group (Table 4). The female pupils and students were more often diagnosed with a higher position of the left pelvis whereas the elderly group with the right side of the pelvis. The asymmetric position of the shoulder girdle with the upper left shoulder was characteristic of the people from all three groups. Very rarely, perfect torso balance was observed in the frontal plane. A left-sided bending was typical of the pupils and students, whereas a right-sided bending was characteristic of the seniors. Side bendings of the spine were less frequently observed among

the seniors. In each group, left-sided bendings were more frequent than right-sided ones.

## Discussion

Epidemiological studies show that overloads and motor organ pain resulting from abnormal body posture are a significant social problem. Some authors draw attention to the fact that women are more likely to experience bad postures [3, 9–11]. The authors' own analysis confirmed that an incorrect torso position affects a significant percentage of women of all ages, and the element of posture apparently differentiating girls, young women and the elderly is the quality of the spine position in the sagittal plane.

Sometimes, it is adolescence that is particularly conducive to the development of postural disorders. The intensive growth rate, the associated temporary weakening of the muscular ligament apparatus, carrying schoolbags that are too heavy and

**Table 4.**

Torso position in the frontal plane in the groups under examination

	Pelvic tilt [°]		
	normal	right-side above	left-side above
<b>Pupils</b>	n=0 0%	n=19 38%	n=31 62%
<b>Students</b>	n=0 0%	n=24 48%	n=26 52%
<b>Seniors</b>	n=1 2%	n=28 56%	n=21 42%
	Shoulders tilt [°]		
	normal	right-side above	left-side above
<b>Pupils</b>	n=0 0%	n=22 44%	n=28 56%
<b>Students</b>	n=0 0%	n=18 36%	n=32 64%
<b>Seniors</b>	n=0 0%	n=16 32%	n=34 68%
	Trunk inclination in the frontal plane [°]		
	normal	tilt to the right	tilt to the left
<b>Pupils</b>	n=1 2%	n=22 44%	n=27 54%
<b>Students</b>	n=0 0%	n=18 36%	n=32 64%
<b>Seniors</b>	n=1 2%	n=30 60%	n=19 38%
	Side bending of the spine [°]		
	normal	right-sided bending	left-sided bending
<b>Pupils</b>	n=36 72%	n=5 10%	n=9 18%
<b>Students</b>	n=38 76%	n=0 0%	n=12 24%
<b>Seniors</b>	n=46 92%	n=1 2%	n=3 6%

spending most of the time in a careless sitting position all increase the risk of bad posture. Therefore, the body posture of children at this age is a common cause of concern for parents, doctors and physiotherapists. The studies presented for the group of 12-year-old girls were characterized by asymmetry of the position of the shoulder and pelvic girdle, deviation of the spine axis from the vertical in the frontal plane and deepening of thoracic kyphosis and lumbar lordosis. In Janusz's studies, asymmetry of shoulder and pelvic posture was also considered the most common posture abnormality among young girls [12]. The deepening of thoracic kyphosis and lumbar lordosis, although frequently observed among the 12-year-olds under examination, did not distinguish them in a statistically significant way when compared to the other groups. Interestingly, shallow chest kyphosis was also most frequently reported among the youngest subjects. These results do not confirm the observations of Sedighe and Jamshih, in which both excessive kyphosis and lordosis distinguished children aged 11–14 from the 19–23-year-olds [13]. In a similar age group (school age), Górnjak observed scoliosis in 32.7% of the girls examined; interestingly, structural scoliosis occurred in 2.5% of the subjects and they concerned only girls [3]. The youngest age group was also diagnosed with the highest number of lateral vertebral arches (28%) in our own studies. Left-sided bendings dominated. Another feature clearly differentiating the female pupils from the other women was the excessive tilt of the trunk backwards. It was diagnosed in 42% of the female pupils, twice as often as among the female students and four times as often as among the female seniors.

Among the female students under examination, breast hyperkyphosis and lumbar hyperlordosis were observed more often than in the other groups. Side bending of the spine was less frequent among them than among the female pupils. They also had a much better balance of the torso in the sagittal plane. Torso asymmetry in the frontal plane was as common in this group as in the other ones. This is confirmed by the studies of Kinel et al., who observed the correct shoulder position only in 15% of subjects of a similar age [14]. The incidence of scoliosis in the group of young women was estimated by Malepe et al. at 1.6% [15]. This result significantly differs from our own observations, which indicate the presence of lateral spinal bends in 24% of the female students. The difference is likely to be due to the use of a different diagnostic method and more restrictive criteria.

The third of the groups under examination consisted of women between 60 and 84 years of age. As it is commonly known, the aging process has very diverse dynamics depending both on environmental factors, genetic conditions and lifestyle, but it is nevertheless associated with a number of involutory changes, some of which, such as bone mineral density reduction, muscle mass reduction, articular cartilage degeneration and the sagging of the ligaments contribute not only to a decrease in physical fitness, but also to a deterioration in posture [2, 5, 16]. Kabsch's research shows that the characteristic feature of the body posture

of elderly people is a deepened thoracic kyphosis and the concomitant clear forward inclination of the torso [17]. Such a posture is perceived as one of the first symptoms of human aging [18].

In a study conducted by Anwajler et al., among 75 people over 60 years of age as many as 97.3% of the people were shown to have a forward inclination of their torso, which was accompanied by shallow lumbar lordosis and compensatory deepening of thoracic kyphosis. About 60% of the women under examination were characterized by a kyphotic body posture, 27.5% of them showed a balanced body posture, whereas 12.5% had a lordotic body posture [1]. Also studies by Drzał-Grabiec et al. indicate deepening of thoracic kyphosis among women belonging to this age group in comparison to younger women [6]. The age-related increase in thoracic kyphosis is also confirmed by the results of other studies [7, 19, 20]. However, no similar correlation was observed in our own study. In the groups of seniors and female students, virtually the same mean values of thoracic kyphosis angle were recorded (46.88 and 46.93, respectively). Moreover, in the group of the seniors, 50% of the respondents had excessive kyphosis, whereas in the group of the students the percentage amounted to 68%. The seniors, on the other hand, were characterized by shallow lumbar lordosis. Hypolordosis was observed in every third woman from the senior group, which was more often than among the women from other groups.

## Conclusions

The element of the body posture most significantly differentiating women between 12 and 84 years is the size of lumbar lordosis. Hyperlordosis is most common among young adult women and hypolordosis among older women. Age has a greater impact on the torso position in the sagittal plane than in the frontal plane.

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## Streszczenie

**Wstęp:** Prawidłowa postawa ciała jest trudna do zdefiniowania. Zmienia się w zależności od płci, wieku oraz kondycji psychofizycznej. Zawsze jednak jest jednym z wyznaczników zdrowia i sprawności funkcjonalnej. Celem prezentowanej pracy było porównanie postawy ciała kobiet w trzech okresach ontogenezy: dziewcząt w okresie dojrzewania, młodych dorosłych kobiet oraz kobiet w wieku geriatrycznym.

**Material i metody:** Obserwacją objęto 150 kobiet: 50 uczennic 12-letnich, 50 studentek w wieku 20–22 lat i 50 kobiet pomiędzy 60. i 84. rokiem życia. Zmierzono wysokość i masę ciała badanych, obliczono wskaźnik BMI i określono status masy ciała jako norma, nadwaga lub otyłość. Z wykorzystaniem ultradźwiękowego systemu Zebris Pointer oszacowano wielkość kifozy piersiowej i lordozy lędźwiowej, symetrię ustawienia obręczy barkowej i biodrowej w płaszczyźnie czołowej, zrównoważenie tułowia w płaszczyźnie strzałkowej i czołowej oraz ustawienie kręgosłupa w płaszczyźnie czołowej. Wyniki podano w postaci danych ilorazowych i jakościowych. Do analizy zebranego materiału wykorzystano podstawowe statystyki opisowe, tabele licznosci, test Shapiro-Wilka (badanie normalności rozkładu) oraz test Kruskala-Wallisa (porównanie międzygrupowe). Różnice pomiędzy grupami uznawano za istotne, gdy  $p < 0,05$ .

**Wyniki:** Częstość występowania nadwagi i otyłości zwiększała się z wiekiem. Badane nie różniły się znacząco wielkością kifozy piersiowej, chociaż spłylenie kifozy obserwowano częściej u uczennic a pogłębienie u studentek. Studentki miały istotnie większą lordozę lędźwiową w porównaniu do pozostałych grup. Spłylenie lordozy notowano najczęściej u senierek. Studentki i seniorki różniły się także pod względem zrównoważenia tułowia w płaszczyźnie strzałkowej. Nadmierne pochylenie tułowia w tył diagnozowano u 42% uczennic, dwa razy rzadziej u studentek i cztery razy rzadziej u senierek. Asymetria barków i miednicy była powszechna w każdej z grup wiekowych. Najwięcej wygięć bocznych kręgosłupa występowało u uczennic. Dominowały wygięcia lewostronne.

**Wnioski:** Wady postawy ciała występują powszechnie u kobiet w każdym wieku. Najczęściej obserwuje się asymetryczne ustawienie barków i miednicy oraz pogłębienie kifozy piersiowej i lordozy lędźwiowej.

**Słowa kluczowe:** postawa ciała, kobiety, wady postawy

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