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Postural Changes in Morbidly Obese Patients

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Background: Postural deviations in morbidly obese individuals may contribute to low self-esteem and to long-term adverse effects on bones and joints. In a case-control study, the axial skeleton was investigated, to disclose the main abnormalities found in obese compared to non-obese groups.

Methods: 2 groups were compared. *Group 1,* severely obese patients (n= 32), age 41.5 ± 8.2 years, BMI 49.4 ± 6.6 kg/m^2, 93.8% females, and *group 2* non-obese (n= 30), age 43.5 ± 5.8 years, BMI 24.6 ± 5.1 kg/m^2, 96.7% females, had their posture analyzed through clinical examination and radiological imaging. Variables measured were anterior, lateral and posterior angular deviation from the vertical body axis at the head, shoulders, pelvis, Thales triangle, spine, knees, ankles and feet. Data are shown as a percentage of abnormal angles in the 2 groups.

Results: On anterior analysis of the 2 groups, disturbances affected head (37.5% vs 13.3%), Thales angle (78.1% vs 53.3%), knees (84.4% vs 33.3%), legs (59.4% vs 30.0%) and support base (59.4% vs 26.7%) (P<0.05). On posterior view, the spine was the deranged segment (87.5% vs 36.7%) (P<0.05), and on lateral assessment, 100% of the results were abnormal.

Conclusions: 1) Individuals with morbid obesity present important postural alterations. 2) Seriously altered posture was the rule for the obese population in this study, especially in the spine, knees and feet. 3) Most patients had compatible clinical complaints, but they rarely associated the bone and joint pain with the obesity and axial skeleton deviations. 4) Planned physical activity should be part of the treatment of severe obesity, in order to correct deviations, prevent new ones, and improve quality of life.

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Introduction

Morbidly obese individuals are at high risk for physical and physiological derangements because of the disease itself as well as its co-morbidities. Besides arterial hypertension, diabetes, cardiovascular disorders, degenerative joint disease, sleep apnea, steatohepatitis, and increased vulnerability to injury,[1] these patients usually present bad posture that may contribute to both low self-esteem and additional long-term adverse effects on bones and joints. Posture is defined as the position in which the body must be held in order to stay upright, balancing the effects of gravity through muscular interaction. Ideal posture is the positioning of the body against gravity in an efficient manner, so that muscular and skeletal interplay keeps the body aligned to the gravitational axis, with the least strain on supporting muscles and ligaments, and with maximum efficiency during movement or weight-bearing activities.[2,3]

Postural deviations occur when misaligned parts of the body cause increased muscular stress to maintain proper balance.[4] The relationship between obesity and bone-joint alterations results from the excessive body weight, with less stability and higher mechanical demands for body adaptations.[5] Adaptation of the body for daily activities has been happening throughout human evolution, since the upright position was assumed, and has been leading to a progressive process of anatomic and physiological steps, in order to always keep the center of gravity at the superior part of the body between the hip joints.[6]

The obese individual often displays a protruding abdomen which results in anterior displacement of the center of gravity, associated with an increase in lumbar lordosis and anteversion of the pelvis. Thoracic kyphosis is also exaggerated, resulting in reactive cervical lordosis and leading to protrusion of the head. Along with the mentioned anterior inclination of the pelvis (anteversion), internal rotation of the hips, widely separated (genu valgum) knees and flat feet (pedis planus) due to collapse of plantar arch, are frequent aberrations.[7]

Postural deviations are not static but dynamically attempt to balance the excess body weight by means of mechanical adjustments.[8] Taking into account the above facts, obesity should be considered as a multifactorial and pluri-systemic body-axis problem. The purpose of this study was to define the main abnormalities found in a series of obese individuals.

Methods

A case-control study was conducted. Group 1 (32 obese patients) and group 2 (30 non-obese subjects) had their posture analyzed through clinical examination (Table 1). Controls were healthy volunteers. Anterior, lateral and posterior angular deviations from the vertical axis of the body were measured at the head, shoulders, pelvis, Thales triangle (angle formed by trunk and arms), spine, knees, ankles and feet, through a modified method employing a posture-measuring device (symmetrograph). Data are shown as a percentage of abnormal angles in the population. Body weight and height were measured using an anthropometric scale. In order to avoid factitious postural deviations, patients were instructed to stand as normally as they would at home or at work, with their arms hanging loosely along the body, and staring forward.

On anterior view, patients were facing the therapist with their back toward the symmetrograph (Figure1). They were checked for position of the head, level of shoulders and hips, Thales triangle, and deviations of the spine, knees, ankles and feet.

On both right and left lateral views, other details such as protrusion and posterior version of the head, protrusion and rotation of the shoulders, alignment of the spine, anteversion and retroversion of the pelvis, semiflexion and hyperextension of the knees, as well as contact of the feet with the floor were assessed (Figure 2).

On posterior view, patients were facing the symmetrograph (Figure 3).

Apart from the items registered on anterior view, the level of the gluteal folds and popliteal lines were also documented. All changes were considered significant when different from those observed in the control population.

Table 1. Characteristics of groups 1 and 2

Characteristic	Group 1	Group 2
Age (yr)	41.5±8.2	43.5±5.8
BMI (kg/m^2)	49.4±6.6	24.6±5.1
Gender (m/f)	93.8% f	96.7% f
N	32	30

Values are incidence or mean ± SD. m=male, f=female. Group 1 – obese patients; Group 2 – non-obese subjects.

Statistical Analysis

Age and BMI are presented as mean ± SD. Chi-square test (χ^2) was used to compare the obese and non-obese groups in anterior, lateral and posterior view. If the waited number and one cell (table 2x2) was <5, Fisher's Exact Test was used. P <0.05 considered significant.

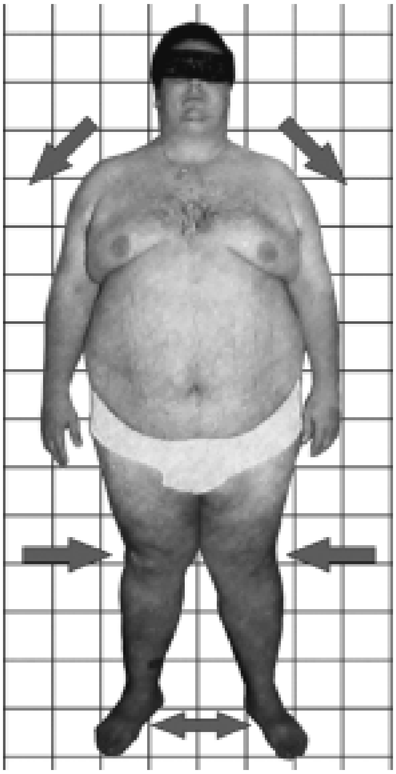

Figure 1. Deviation on anterior view.

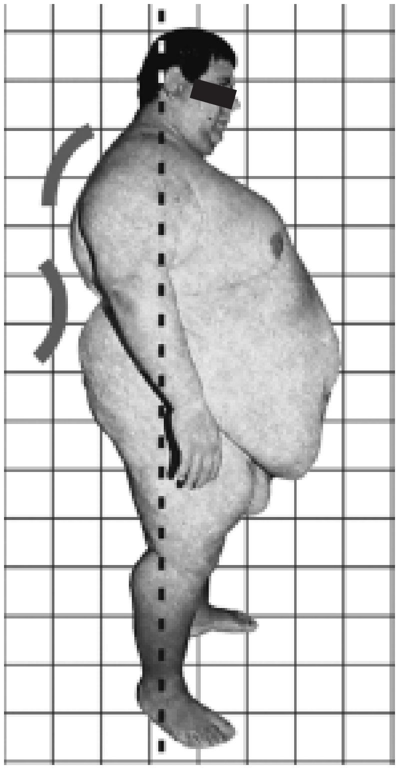

Figure 2. Deviation on lateral view.

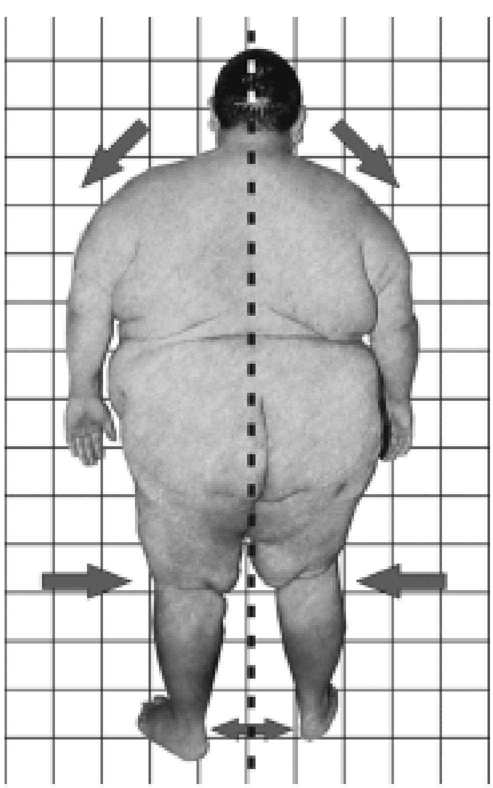

Figure 3. Deviation on posterior view.

Results

On anterior analysis, head (37.5% vs 13.3%), Thales triangle (78.1% vs 53.3%), knees (84.4% vs 33.3%), legs (59.4% vs 30.0%) and support base (59.4% vs 26.7%) were all affected in the obese population ($P<0.05$) (Table 2). On lateral assessment (Table 3), 100% of the results were abnormal. Finally, on posterior view (Table 4), the spine was the only deranged segment (87.5% vs 36.7%) ($P<0.05$).

In summary, these results show a significant adverse effect of obesity on posture involving all major skeletal segments, and conspicuous on all three standard views, with emphasis on the lateral view. Additionally, 84.4% of the assessed population showed genu valgum knees.

Discussion

Excessive body weight represents a burden for the axial skeleton, probably by overstretching and damaging essential ligaments and creating excessive wear and tear for other

Table 2. Results obtained on anterior view

		Number of Individuals		χ^2
		Normal*	Abnormal† values	*P*-value
Head	Group 1	20	12 (37.5%)	0.0298
	Group 2	26	4 (13.3%)	
Shoulder	Group 1	13	19 (59.3%)	0.3162
	Group 2	16	14 (46.7%)	
Thales triangle	Group 1	7	25 (78.1%)	0.0393
	Group 2	14	16 (53.3%)	
Hip	Group 1	13	19 (59.4%)	0.3162
	Group 2	16	14 (46.7%)	
Knee	Group 1	5	27 (84.4%)	<0.0001
	Group 2	20	10 (33.3%)	
Ankle	Group 1	31	1 (3.1%)	1.000
	Group 2	30	0 (0.00)	(Fisher)
Leg	Group 1	13	19 (59.4%)	0.0202
	Group 2	21	9 (30.0%)	
Support base	Group 1	13	19 (59.4%)	0.0094
	Group 2	22	8 (26.7%)	

Group 1 – Obese patients; Group 2 – Non-obese subjects.
*Normal = Individuals without postural alteration.
†Abnormal = Individuals with some postural alteration.

Table 3. Results obtained in lateral view

		Number of Individuals Normal*	Abnormal† values	χ^2 *P*-value
Head	Group 1	5	27 (84.4%)	<0.0001
	Group 2	23	7 (23.3%)	
Shoulder	Group 1	8	24 (75.0%)	<0.0001
	Group 2	23	7 (23.3%)	
Spine – thoracic kyphosis	Group 1	8	27 (84.4%)	<0.0001
	Group 2	23	7 (23.3%)	
Spine – lumbar hyperlordosis	Group 1	7	25 (78.1%)	<0.0001
	Group 2	23	7 (23.3%)	
Hip	Group 1	4	28 (87.5%)	<0.0001
	Group 2	21	9 (30.0%)	
Knee	Group 1	7	25 (78.1%)	<0.0001
	Group 2	25	5 (16.7%)	
Support base	Group 1	5	27 (84.4%)	0.0017
	Group 2	16	14 (46.7%)	

Group 1 – Obese patients; Group 2 – Non-obese subjects.
*Normal = Individuals without postural alteration.
†Abnormal = Individuals with some postural alteration.

structures, thus leading to damage of bones, joints and ligaments, mainly those which directly sustain body weight.

As the spine is the core of body support against the force of gravity, many of the derangements are located here. Severely obese individuals usually present compensatory scoliosis, increased thoracic kyphosis and hyperlordosis, leading to anteversion and lateral version of the head, unleveled shoulders and hips, and an increased Thales triangle.[9]

A wider support base is the consequence of overloading the lower limbs, as the body fights to keep upright by separating knees and ankles and by flexing legs, in order to achieve a lower center of gravity and more antero-posterior and lateral stability. This sequence of adaptative processes may lead to deformities even worse and more irreversible than those found in the spine, as the enlarged support base triggers longitudinal external deviation of the tibia and the femur, causing genu valgum knees, pedis planus, and external rotation of the feet.[10]

Table 4. Results obtained in posterior view

		Number of Individuals Normal*	Abnormal† values	χ^2 *P*-value
Spine	Group 1	4	28 (87.5%)	0.0001
	Group 2	19	11 (36.7%)	

Group 1 – Obese patients; Group 2 – Non-obese subjects.
*Normal = Individuals without postural alteration.
†Abnormal = Individuals with some postural alteration.

All these abnormalities were documented here, thus alerting for increased attention toward these easily overlooked but relevant aberrations. Patients rarely notice postural changes and tend to attribute daily pains and fatigue to excessive body weight by itself. Obviously, anti-obesity operations tend to benefit co-morbidities in general, and postural deformities should be no exception. Nevertheless, few studies have documented actual frequency of these problems, either before or after weight loss.

Without technical assessment, combined with specialized physical therapy whenever necessary, some of these functional responses may convert into true sequelae, thus hampering full recovery from bariatric treatment.

In conclusion, obese individuals deviate their axis of gravity to compensate for excessive overload. Major postural deviations were pinpointed in this study. Evaluation and management of morbidly obese individuals by a multidisciplinary team including physical therapy is recommended, because body image and well-being may then be favorably influenced.

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