ASSESSMENT OF THE STATIC POSTURE DURING STANDING IN OBESE ADOLESCENT GIRLS

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ABSTRACT

Obesity is significantly associated with an endless list of postural disorders. The prevalence of childhood obesity is steadly increasing so it is important to study the effect of obesity on musculoskeletal system on these children to provide meaningful support in prevention and their treatment. ***Aim of the stud****y: the study aims to assess the static posture during standing position among the obese adolescent girls and compare their obtained data with non-obese adolescent girls.* ***Cases and Methods****: One hundred of non-obese adolescent girls (group A) compared with thirty obese adolescent girls (group B). Their ages ranged from 12-14 years old, the mean values ± SD were 13±0.7 and 12.8±1.2 years old for both groups respectively. All participated girlwere evaluated when they were on static standing position from sagittal view using photography. AutoCAD (Computer Aided Design) was used to analyze the photographic posture. The posture measurements was achieved through analysis of five angles (cervico-thoracic angle, trunk angle, lumber angle, pelvic tilt angle, sway angle) to quantitatively assess the positioning of several body segments in the upright .* ***Results*** *: The results of this study revealed significant differences when comparing the mean values of the measuring angles between obese adolescent girls and non-obese adolescent girls.* ***Conclusion:*** *Obesity may have a greater effect on static posture. These effects on obese adolescent girlswere represented by protruded head , hyper kyphosis (dorsal spine), hyper lordosis (lumber spine), anterior pelvic tilting , and increased posture sway .*

Key words *: obese adolescent girls , postural analysis , static standing .*

INTRODUCTION

Obesity is recognized as a major global burden to health, the prevalence of childhood overweight and obesity is steadily increasing **(Magarey et al., 2003**).Overweight children are susceptible to developing bony deformities thatcan predispose them to other orthopedic problemslater in life**(Speiser and Mary 2005).**

Despite the multifactorial nature of musculoskeletal disease, obesity consistentlyemerges as a key and potentially modifiable risk factor in the onset andprogression of musculoskeletal conditions of the hip, knee, ankle, foot andshoulder. To date, the majority of research has focused on the impact of obesity on bone and joint disorders, such as the risk of fracture and osteoarthritis **(Riddleetal.,2003).**

However emerging evidence indicates that obesity may also have a profound effect on soft-tissue structures, such as tendon, fascia and cartilage. Although the mechanism remains unclear, the functional and structural limitations imposed by the additional loading of the locomotors system in obesity have been almost universally accepted to produce aberrant mechanics during locomotors tasks, thereby unduly raising stress within connective-tissue structures and the potential for musculoskeletal injury. While such mechanical theories abound, there is surprisingly little scientific evidence directly linking musculoskeletal injury to altered biomechanics in the obese adult **(Wearing et al., 2006)**

The development of static balance is a basic characteristic of normal motor development, with improved balance control typically observed with maturation **(Parizkova et al., 2005)**.

Research investigating the effect of childhood obesity on postural balance has primarily focused on clinical measures of stability during unipedalor bipedal stance. Similar to findings in children with developmental coordination disorder, obesity appears to have negligible impact on static balance control during normal conditions, but under difficult or novel situations, may result in impaired performance and greater postural sway by presumably altering the joint torque required to stabilize the body **(Geuze et al., 2003)**.

Although adult-onset obesity has been associated with a greater prevalence of musculoskeletal disorders, comparative data in children are lacking. However, there is Evidence that persistent weight-bearing associated with childhood obesity may inhibit normal movement patterns and predispose children to musculoskeletal pain and injury **(Swollen et al., 2005)**.

The aim of the study was to assess the static posture during standing position among the obese adolescent girls and compare the obtained data with on-obese adolescent girls.

CASES, MATERIALS & METHODS

A purposive sample of 30 obese girls Body Mass Index (BMI) 30-40 Kg/m was collected from National Nutrition Institute and 100 non-obese volunteers (BMI18.5-25 Kg/m) were collected from different schools. **Their ages ranges**

from 12-14 years Informed consent for participating in this study was obtained in written form from the caregiver of each adolescent.

***Criteria for exclusion*:**

1- Respiratory or heart problems.
2- Visual and vestibular problems.
3- Back deformities.
4-Deformity of upper or lower limbs
5- Anthropometric abnormal measures.
6- Metabolic disorders.
7- Those who participate in regular sport activities or they were athletes.

METHOD FOR ASSESSMENT:

All participants are subjected to the following:

1. BMI was calculated to all participated girls in both groups.

2. Measure weight and standing height then apply the following formula;

BMI = Weight in kg / height in m2

The BMI was calculated to determine the obese and non-obese girls.

3. Postural evaluation:

In standing position (from static sagittal plane), photo were taken to each participated girls on both groups. Auto CAD (Computer Aided Design) program was used to analyze the posture through the following angles (cervico-thorathic angle , trunk angle, lumber angle, pelvic tilt angle , sway angle) in sagittal view the angles were measured for all participated girls in both groups, **Perry et al., (2008).**

DATA ANALYSIS & STATISTICAL DESIGN

Descriptive statistics:

The mean value and standard deviation were calculated for each measured variable (angle in degrees) in the standing position in both groups.

RESULTS

The participants' demographic data:

Group (A) consisted of one hundred non-obese girls their average BMI ranged from 18-25 kg/m^2, while group (B) consisted of thirty obese girls; their BMI was higher than 30 kg/m^2. For all girls in both groups, their age ranged from 12-14 years old.

These data concerning age, height, weight, BMI demonstrated in tables and illustrated in figures as the following:

A. Age:

As demonstrated in table (1),when comparing the mean values of both groups(A and B), concerning age, the mean values ± SD were 13 ±0.7 and 12.8 ±1.2 years old for both groups respectively there was no significant difference between the mean age value of both group.

(P>0.05)

B. Height:

As demonstrated in table (1), when comparing the mean values of both groups(A and B), concerning height, the mean values ± SD were 154 ±3.0 and 150 ±2.0 in centimeter for both groups respectively.There was no significant difference between the two mean values of height in both groups.(P>0.05)

C. Weight:

In the same table (1), when comparing the mean values of both groups (A and B), concerning weight, the mean values ± SD were 50±2.0 and 76 ±3.0in Kg for both groups respectively.

There was significant difference between the mean values of weight on both groups.(P>0.05)

- ***Dependent variables:***

A. Cervico-thoracic angle:

As demonstrated in table (2), when comparing the mean values of both groups (A and B), concerning cervico-thoracic angles, the mean values ± SD were 146.11±6.231 and 126.5±5.27 (Degrees) for both groups respectively which indicated significant difference between both groups (P<0.05).

B. Trunk angles:

As demonstrated in table (2), when comparing the mean values of both groups (A and B), concerning trunk angles, the mean values+ SD were 196+3.27 and 216+8.06 (Degrees) for both group respectively which indicated significance difference between both groups(P<0.05).

C- Lumbar angles:

As demonstrated in table (2), when comparing the mean values of both groups (A and B), concerning lumbar angles, the mean values ± SD were 90.09±3.73 and 72.4±4.924 (Degrees) for both groups respectively which indicated significance difference between both groups (P<0.05)

D- Pelvic angles:

When comparing the mean values of both groups A and B (table 2), concerning pelvic angles, the mean values ±SD were 32.39±3.37 and 43.83±4.1 (Degrees) for both groups respectively which indicated significance difference between both groups (P<0.05).

E- Sway angles:

As demonstrated in table (3), when comparing the mean values of both groups (A and B), concerning sway angles, the mean values ±SD were 176.42±4.67 and 155.1±3.74 (Degrees) for both groups respectively which indicated significant difference between both groups ($P<0.05$)

DISCUSSION

This study was carried out on adolescent girls on age ranged from12-14 years old because as **William and Dietz (1997)** stated that adolescence represents a period of increased risk for the development of obesity in girls but it is also the period in which the location of body fat changes and thereby may entrain the subsequent risks associated with obesity**.**

And according to **Paul et al (2001)** suggested that overweight girls tend to mature earlier than girls who are not overweight, there is strong evidence that body fat and the initiation of the hormonal events of puberty are in some way related, the increase in body fat and BMI occurring in the per pubertal period as the result of the hormonal changes of early puberty rather than the cause.

Furthermore the selection of age ranged from twelve to fourteen was in purpose to set an early detection of any postural problem and possibility to an early intervention.

As **Penha et al (2008)** stated that the prepubertal phase and puberty are periods of life when posture undergoes many adjustments and adaptations due to changes in the body. From seven to twelve years of age, human posture undergoes major transformations to balance the new body proportions.

These changes in body proportions may be due to differences in bone and muscle tissue growth rates. Therefore it is important to diagnose postural deviations between the ages of seven and 14 years, not only because the child is susceptible to modifications of the bone system but also because poor bone formation and poor posture are more easily corrected at this stage of development.

As demonstrated in our study there was no variation in height as mean because, girls reach their maximum muscle strength earlier (at the menarche) than boys (when their height growth has ended). The gains in strength after puberty are greater for boys than for girls **(Penha et al., 2008)** which come in agreement with the selection of age criteria which is from twelve to fourteen years old.

Data shows there was a great variation in weight between the both groups which lead to also to great variation in BMI. This was come in agree with the selection of weight, BMI criteria which is one hundred of non-obese adolescent girls selected with BMI from 18.5- 25Kg/m2 and thirty of obese adolescent girls selected with BMI from 30-40 Kg/m2

This study provides information about static sagittal posture to the adolescent girls, with posture expressed as five angles derived from coordinates of anatomical points, calculated electronically from photographs, and analyzed through Auto DESK Auto CAD 2007 since as **Oliveira et al (2008)** stated that the usage of the photographic register is capable to mark subtle transformations and to interrelate different parts of the body that are difficult to measure.

Results showed there was a greater postural changes in obese girls that affect the maintenance of erect posture and impose a new biomechanical constraint which come in agreement with **Francesco et al (2009)** who stated that the excessive amount of fat modifies the body geometry by adding passive mass to different regions and it influences the biomechanics of activities of daily living, causing functional limitations, and possibly predisposing to injury.

The postural changes that observed in this study in form of five angles showed that there was a significant difference in the measuring angles between the obese and non-obese adolescent girls. Firstly, at cervico-thoracic angle which is defined as an angle between line of tragus to C7 and line of C7 to T12 (measured anterior to intersect), it represent the alignment of the head on trunk **(Perry et al., 2008).**

This difference in the cervico-thoracic angle in both groups of our study clarified that there was head protrusion on the obese girls. These findings supported by **Andrezza et al (2012)** who said that there was a head protrusion due to the overload impacted on the spine .

The difference in the trunk angles in our data indicated that there was a hyper kyphosis in dorsal curve when the weight increased and this come in agreement with **Anne et al(2011)** who stated that there was in relationship between standing posture and weight in children and adolescents. Greater weight at 14 years of age is associated with higher trunk angle which mean there was a hyper kyphosis with increased BMI

In this study there was a decreasing in balance with increasing BMI especially when the kyphotic and lordotic curves increased and there was an abdominal protrusion. These were supported by the study of **Anne et al (2012)** in children and adolescents there also appear to be a relationship between standing posture and weight. Greater weight at 14 years of age is associated with hyperlordotic and sway standing postures and sway standing postures were more commonly associated with obesity.

As **Francesco et al (2009)** who stated that body weight is a strong predictor of postural stability, with obesity-associated postural perturbations appearing in adolescence. In particular, obesity has been associated with greater forward displacement of the CoP during dynamic standing balance activities so the increased body mass in the obese individuals causes an increase of torque at ankle level, and consequently, an increased demand of muscle strength and activity to maintain the center of pressure within the base of support.

This study has suggest that there is may be association with specific spinal pathologies in adulthood, and these body postures may have a detrimental effect on spinal structures across the lifespan. These findings support early-targeted interventions to prevent obesity in order to reduce the burden of low back pain and other related co-morbidities.

The lumber angle was defined by **Perry et al**

(2008) an angle between comparing the mean values of both groups, concerning trunk angles, the mean values ± SD of the non-obese subjects were 196±3.27 and for obese subjects were 216.5±8.06 (Degrees) which indicated significance difference between both groups.

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RECOMMENDATION

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Table (1): The mean age، height, weight and body mass indexin non-obese and obese girls

Variable	Non-obese Mean ±SD	Obese Mean ±SD
Age (in years)	**13 ± 0.7**	**12.8 ± 1.2**
Height (in cm)	**154 ± 3.0**	**150 ± 2.0**
Weight (in kgm)	**50 ± 2.0**	**76 ± 3.0**
Body Mass Index (BMI)	**21.1± 8.42**	**34.2± 3.91**

Table (2): The vertebral angles of non - obese and obese girls

Dependent variable	Non-obese Mean ±SD	Obese Mean ±SD	T-value	P-value
Cervico-thoracic angle (degree)	**146.11±6.23l**	**126.5±5.27**	**-0.5399**	**0.000***
Trunk angle (degree)	**196±3.27**	**216.5±8.06**	**1.408**	**0.000***
Lumber angle (degree)	**90.09±3.73**	**72.4±4.924**	**-1.054**	**0.000***
Pelvic angle (degree)	**32.39±3.37**	**43.83±4.1**	**0.9085**	**0.000***

Table (3): The sway angles in non-obese and obese girls

Dependent variable	Non-obese	Obese	T-value	P-value
Sway angle (degree)	**Mean ±SD**	**Mean ±SD**	-1.064	**0.000***
	176.42±4.67	**155.1±3.74**		

***Significant at alpha level <0.05**

تقييم العمود الفقري فى وضع الوقوف الثابت لدي مجموعة من المراهقات البدينات

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الملخص العربي

زيادة الوزن والسمنة لهم علاقة وثيقة بكثير من الأمراض المتعددة، وتعتبر السمنة في الأطفال في ازدياد مستمر لذا من المهم دراسة تأثير السمنة علي الجهاز الهيكلي العضلي في الأطفال لتقديم برامج الحماية العلاج المناسب لهؤلاء الأطفال. الهدف من الدراسة هو تقييم العمود الفقري في وضع الوقوف الثابت ويتمثل في عدة زوايا (زاوية الرقبة والفقرات الصدرية للظهر ، زاوية جزعيه ، زاوية قطنية ، زاوية الحوض ، زاوية التمايل) عند المراهقات البدينات ومقارنتها بالمراهقات الغير بدينات من سن الثاني عشر إلي سن الرابع عشر سنه . تم إجراء البحث علي مائه من المراهقات الغير بدينات (أ) ومقارنتها بثلاثين من المراهقات البدينات (ب) ، تتراوح أعمارهن من سن ١٢--١٤ سنه عمريه ، تم اخذ المتوسط لدي الفتيات وكان ١٣±٠,٧ و١٢,٨±١,٢ سنه عمريه ، للمجموعتين بالترتيب وقد تم تقييم العمود الفقري لديهن عن طريق تصويرهن بواسطة برنامج أوتوكاد لقياس الزوايا (زاوية بين الرقبة والفقرات الصدرية للظهر، زاوية جزعيه، زاوية قطنية، زاوية التمايل). وقد أظهرت النتائج وجود فوارق ذات دلالة إحصائية بين المراهقات البدينات والمراهقات الغير بدينات في جميع الزوايا ألمقاسه. نستنتج من هذا أن السمنة ربما لها تأثير علي العمود الفقري في وضع الوقوف الثابت يتمثل في بروز الرأس للأمام ، انحناء حاد بالفقرات الصدرية للعمود الفقري، زيادة المنحني القطني في العمود الفقري للداخل، زيادة ميل الحوض للأمام وأخيرا زيادة ميل الجسم للأمام.

الكلمات الدالة *: المراهقات البدينات ، تقييم العمود الفقري ، وضع الوقوف الثابت.*