59 - THE INFLUENCE OF THE USE OF HIGH HEELED SHOES IN THE CURVATURES OF THE SPINE

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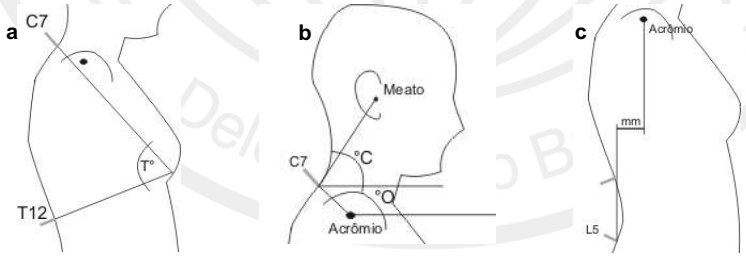
INTRODUCTION

Ideal posture of an individual consists in sustaining musculoskeletal balance, independently of its body part organisation. It includes a small energy demand and improved efficiency (LEHMKULL e SMITH, 1989). Further, ideal posture reduces the incidence of injuries and deformities of the apparatus (ADAMS & HUTTON 1985). Therefore, body posture can be gradually modified by mechanical stress and muscle imbalance increasing the forces applied in the structure that may lead to discomfort, pain and disability (WATKINS, 1999). Changes in the physiological curves of the spinal column may reduce the ability of the structure to respond to external stimulus (ADAMS e HUTTON, 1985; WATKINS, 1999). The source of several problems in the spine may cause local and irradiate pain (HALL & BRODY, 1998). Low back pain is one of the most common problems among the occidental population (SYMMONS et al., 1991) and affects from 50 to 84% of adults in some phase of their lives (DIONNE, 1999). Women are more prone to develop low back pain than men (Lake et al, 2000). Although low back pain is multifactorial, long periods in repeated posture may cause cumulative loads on the musculoskeletal system and may account for dysfunctions later in life (VIEIRA & MARRAS, 2004). The use of high heeled shoes induces women to assume a modified posture (KLUG-MARING, 1982) and may be one contributing factor to the higher incidence of low back pain in women (FRANKLIN et al. 1995). A number of studies (MANFIO et al., 2003; OPILA et al., 1988) have reported a reduced lumbar lordosis curve in subjects wearing high heeled shoes. On the other hand, Klug-Maring (1982) showed that high heeled shoes increased the lumbar lordosis angle. Others (De LATEUR et al, 1991; SNOW & WILLIAMS, 1994; LEE JOENG & FREIVALDS, 2001) have showed no significant changes in the curves of the spine. These studies showed no consistent findings and further investigations are required. The aim of this study was to determine the influence of wearing high heeled shoes over the spinal arrangement. A better understanding of the influence of high heeled shoes may help to organize strategies that reduce the problems related to use of this shoe type.

METODOLOGY

Prior further assessments, participants were informed of the procedures involved in the study and agreed to volunteer. Twenty healthy women (age = 24,0 ± 4,0 years and BMI = 21,1 2,0 kg/m²), reported no health problems that could influence the tests of the study and were back problems free during the 12 months that preceded the study. Participants visited the laboratory for a single session in which their physical characteristics and posture were determined. Posture was determined by photometry in two instants, i.e., with (9.0 cm) and without high heeled shoes. The spinal processes of C7, T12, L5 and the acromium were identified and marked over the skin by only one experimenter. Although Billis et al. (2004) showed good repeatability to locate these body landmarks, variations were deemed minimal since markers were not removed during the experiment. Photographs were taken using a digital camera (SONY P-93, 5.2 Megapixels), perpendicularly positioned on the right sagittal plane in an distance (~ 2.5 m) that allowed clear view of the spine and the head. To determine the position of the spinal processes in the sagittal plane, a set of self-adhesive protruded markers (4 cm long) were used. Participants assumed a usual relaxed posture and remained in a natural posture during the assessment. The curves of the spine (thoracic and lumbar) were determined by extending the spinal processes markers. Figure 1a shows a schematic representation of the landmarks' position and the respective spinal angles. This method has been long applied by Christie et al. (1995). The position of the head and shoulder were determined using the method proposed by Braun & Amundson (1989). The head position was determined by the angle formed by the line between the external acoustic meatus and C7 with the horizontal, while the shoulder position was determined by the angle formed by the line between C7 and the acromium and the horizontal. These angles are represented in Figure 1b.

FIGURE 1 - Schematic representation of the landmarks and angles used to determine posture.



(a) thoracic angle; (b) angle of projection of the head and shoulder; (c) horizontal displacement of the acromium.

In addition, the horizontal displacement of each landmark with respect to the basis of the lowest marked spinal process (L5) was also determined in both experimental conditions (with and without high heeled shoes). Figure 1c shows a schematic representation for the horizontal displacements (ex. acromium horizontal displacement). Standard descriptive statistical analysis was performed (mean ± standard deviation) and the Kolgomorov-*Smirnov* test was applied to determine data normality. The experimental conditions were compared by the Student t test, which was applied in a number of variables. Statistic analysis was performed in the software *Statística* ® and significance level set at p = 0.05.

RESULTS

The results can be visualised in TABLE 2. Shoulder angle increased ($p<0.05$) when participants wore high heeled shoes. Head and C7 horizontal displacement also changed in response to shoe use and significant changes were found ($p<0.05$). TABLE 3 shows the horizontal displacements of the landmarks.

TABLE 2 - Angles found in the individuals without and with high heeled shoes

	Head Position	Shoulder Position	Thoracic angle	Lumbar angle
No heel	58,15° ± 5,8°	150,12° (±13,98°)*	42,61° ± (9,91°)	34,47° (±11,49°)
High heel	59,33° ± 6,78°)	159,51° ± (13,49°)	40,22° (±9,17°)	33,71° (±11,41°)

TABLE 3 - Projection of the head, shoulder, C7 and T12 in the posture with high heeled shoes.

Head	Shoulder	C7	T12
7,03% ± 0,81%*	9,47% ± 3,57%	34,8% ± 19,7%*	122,26% (±152,48%)

*p < 0,05; Values are expressed in terms of percentual of the condition without shoes.

DISCUSSION

Data analysis demonstrated changes in postural arrangement in response to the use of high heeled shoes. No changes were observed in the spinal angles (thoracic and lumbar angle). The angular variables analysed in the present study were similar to those reported by Snow & Williams (1994), who assessed postural changes using shoes of 19.1, 38.1 e 76.2 mm. Lateur et al. (1991) also found no significant changes in the spinal profiles using a range of heels in a group of experience in using high heel shoes.

The only angular change in the present study occurred around the shoulder joint, which was more protruded when participants wore high heeled shoes. The horizontal displacement of the shoulder joint was also moved forwards. In fact, the horizontal displacement of the distal markers of the body were moved forward, as if participants moved the upper parts of the body to assume a more flexed posture during the use of high heeled shoes. The head and the upper markers are where most adaptations are more prone to occur because they are closer to the extremity of the free end. The intermediate markers can not move as free as the more distal ones due to its confined and restricted movements (Twomey & Taylor, 1983). It seems that small changes in body parts are responsible for changes in the system mass centre. Snow & Williams (1994) also reported the use of a more flexed posture when high heeled shoes were worn, although no changes around the shoulder were detected.

The use of high heeled shoes causes a rise and forward projection of the centre of mass (Snow e Williams, 1994) and reduction of the support base (Nyska et al. 1996) and may require greater activation of the paraspinal muscles to resist the bending moment created by the tendency to flex the trunk, as reported by Lee Jong & Freivalds (2001). Therefore, a greater physiological demand is required to sustain body organization and fatigue and its adverse effects may also appear if the task is continually performed. Mathews and Wooten (1963) showed increased metabolic responses (greater O_2 consumption) with the use of high heeled shoes, but no changes in the centre of mass were detected. They proposed that small internal postural changes would have a null net effect (canceling each other), producing negligible alterations over the position of the centre of mass, but marked increase in terms of physiological demand. Experience may play a role and is an important factor to be accounted in future studies. For instance, a study performed by De Lateur et al (1991) showed reduced lumbar angle in response to high heeled shoes, while women did not. Therefore, longitudinal studies are also required to observe whether long term postural adaptations are present.

The effects of high heeled shoes over posture remain unclear. Contradictory reports found in the literature must be interpreted with caution as the number of subjects is frequently reduced. Variations in the methods used to determine posture and the convention of the spinal curves are also a limitation. Other studies analyzing muscle activation (EMG) and plantar pressure distribution are essential to understand the acute and long term effects of high heeled shoes use.

CONCLUSION

It was concluded that the use of high heeled shoes did not cause changes in the curves of the spine. However, changes in the horizontal displacement of the upper markers suggest the use of a more flexed posture of the vertebral column. It is suggested that small internal changes in several levels of the spine contributed to changes in posture, although such changes were not translated in terms of angular variations that are generally used to determine posture.

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ABSTRACT

The aim of this study was to determine the influence of wearing high heeled shoes over the spinal arrangement. Twenty healthy women (age = 24,0 ± 4,0 years and BMI = 21,1 2,0 kg/m²) were valued. Posture was determined by photometry in two instants, i.e., with (9.0 cm) and without high heeled shoes. The spinal processes of C7, T12, L5 and the acromium were identified and marked over the skin. The used methods has been long applied by Christie et al. (1995) and Braun & Amundson (1989). Shoulder angle increased ($p<0.05$) when participants wore high heeled shoes. Head and C7 horizontal displacement also changed in response to shoe use and significant changes were found ($p<0.05$). The use of high heeled shoes did not cause changes in the curves of the spine. However, changes in the horizontal displacement of the upper markers suggest the use of a more flexed posture of the vertebral column. It is suggested that small internal changes in several levels of the spine contributed to changes in posture, although such changes were not translated in terms of angular variations that are generally used to determine posture.

Keywords: Postural variation, vertebral column, posture.

L'INFLUENCE DE L'UTILISATION DES CHAUSSURES A TALON SUR LES COURBES DE LA COLONNE VERTEBRALE

RESUMÉ

L'objectif de cette recherche était de vérifier, dans la coupe sagittale, les changements de posture occasionnés à la poitrine en fonction de l'utilisation des chaussures à talon. Le groupe d'étude a été formé avec 20 femmes d'age moyenne de 24,05 (4,06) ans et IMC 21,11 (2,06) $Kg.m^{-2.}$ Les individus ont participé à une seule séance d'évaluation dont nous avons pris des photos de la coupe sagittale. Nous avons délimité des références au meato auditif externe et à l'acromion, ensuite fixés des tiges sur la peau, puis les vertèbres C7, T12 et L5 pour que cela puísse nous aider à analyser les variations sur la posture des individus, en fonction de l'utilisation des chaussures à talon.

Nous avons trouvé des altérations significatives sur l'angle de l'épaule et la projection horizontale de la tête et de la vertèbre C7. Donc l'utilisation de chaussures à talon a occasionné des altérations posturels, par contre il est nécessaire faire encore d'autres études pour vérifier le comportement du centre de gravité et aussi l'activation musculaire nécessaire pour la maintenir la posture statique.

Mot clés: Posture, Changement Posturel, Colonne Vertébrale.

LA INFLUENCIA DEL USO DE LOS ZAPATOS DE TACONES EN LAS CURVATURAS DE LA ESPINA

ABSTRACTO

El objetivo de este estudio era determinar la influencia de los zapatos de tacones en la espina. Veinte mujeres saludables (la edad = 24,0 ± 4,0 años y IMC = 21,1 2,0 kg/m²) fueron estimados. La postura era determinada por photometry en dos momentos; con (9.0 centímetro) y sin los zapatos de tacones. Los procesos espinales de C7, T12, L5 y los acromium fueron identificados y marcados encima de la piel. Los métodos usados han sido mucho tiempo aplicados por Christie et al. (1995) y Braun & Amundson (1989). El ángulo del hombro aumentó ($p < 0.05$) cuando los participantes llevaron los zapatos de tacones. La cabeza y C7 que también el desplazamiento horizontal cambió en la contestación para herrar uso y los cambios significantes ($p <0.05$). El uso de los zapatos de tacones no causó variation en las curvas de la espina. Sin embargo, las variationes en el desplazamiento horizontal de los marcadores superiores hacen pensar en el uso de una postura más encorvada de la columna vertebral. Se sugiere que pequeños variationes interiores en varios niveles de la espina contribuidos a los cambios en la postura, aunque no se tradujeron los tales cambios por lo que se refiere a variaciones angulares que generalmente usa determinan la postura.

Palabras-claves: Variación postural, columna vertebral, postura.

A INFLUÊNCIA DO USO DE SAPATOS DE SALTO NAS CURVATURAS DA COLUNA VERTEBRAL

RESUMO

O objetivo deste estudo foi verificar, no plano sagital, as alterações posturais ocorridas no tronco em virtude do uso de sapatos de salto alto. A amostra foi constituída por 20 indivíduos do sexo feminino com idade média de 24,05 (4,06) anos e IMC 21,11 (2,06) $Kg.m^{-2}$. Os indivíduos participaram de uma única sessão avaliativa na qual foram coletadas fotos do plano sagital. Foram demarcados pontos no meato auditivo externo e acrômio e fixadas hastes na pele sobre as vértebras C7, T12 e L5 para que fosse possível analisar as variações na postura dos sujeitos em função da utilização do calçado de salto alto. Foram encontradas alterações significativas no ângulo do ombro e na projeção horizontal da cabeça e da vértebra C7. Desta forma a utilização de sapato de salto alto causou alterações posturais, todavia se faz necessário outros estudos que verifiquem o comportamento do centro de gravidade bem como a ativação muscular da musculatura envolvida na manutenção da postura ortostática.

Palavras-chave: Postura, Alterações Posturais, Coluna Vertebral.