P14- Origins of the dangerous posturo-kinetic behaviour in android obesity during a whole body reaching movement

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To better adapt prevention and/or rehabilitation programs, it is important to accurately analyse the posturo-kinetic disorders in daily life situations and to determine their origin. Twelve severe android obese adults and eight healthy non obese adults performed a reaching task mobilizing the whole body. Movement kinetics and kinematics characteristics were evaluated by use of an optoelectronic system triggered with a force platform. Results showed in obese patients a significant decrease of movement velocity with a strong increase of CoM displacement towards the BoS boundary and an important spatio-temporal desynchronization of the focal and postural components between the descending and ascending movements. The origins of these postural disorders in obese patients seem to result from the combination of biomechanical constraints, physical lifestyle and specific neurophysiological properties.
Keywords: whole body reaching; equilibrium; obesity; postural control; functional activity

INTRODUCTION

Obese people suffer from postural control disorders and are more subject to falls than their lean counterpart (Mignardot et al., 2010; Menegoni et al., 2009; Hue et al., 2007). From a morphological point of view, obesity is characterized by an excessive fat mass accumulation (Basdevant et al., 2008). The distribution of this additional mass is uneven across the body regions, and in obese android patients it is mainly located on the trunk and particularly in the abdominal area (Chowdhury et al. 1994; Kotani et al., 1994). Thus, for a same body position, changing weight distribution changes de facto the CoM location in obese patients. It is likely that these anthropometric constraints disrupt daily living activities. The present study aimed to evaluate, through the analysis of an everyday life task mobilizing the whole body, to which extent the obese motor behaviour meets their lean counterpart. In a second step, it aimed to identify the role of some biomechanical and cognitive factors underlying their posturo-kinetic behaviour. To better understand the role of biomechanical constraints, we compared the behaviour of non obese participants with and without a simulated obese morphology. To better understand the role of physical lifestyle factor, we compared the behaviour of the most physically active obese patients with their inactive counterpart.

METHODS AND PROCEDURES

Twelve severe android obese adults (age = 47.1 ± 16 years, BMI = 36.6 ± 3.3 Kg/m²) and eight healthy non obese adults (age = 41.6 ± 14.8 years, BMI = 21.4 ± 2 Kg/m²) performed a reaching task mobilizing the whole body. To further determine the origin of the postural motor behaviour differences, six out of the eight non obese individuals also performed an experimental session with additional constraints (additional mass on the trunk and adjunction of a deformable rigid foam cube, without mass, at the level of the pelvis to reproduce the discomfort felt by a thick fat pad) which simulated obese morphology. Impact of the sedentary lifestyle was also studied by dissociation of the obese group in two sub-groups of physically « active » and « inactive » patients. Movement kinetics and kinematics characteristics were evaluated by use of an optoelectronic system triggered with a force platform. The mechanical equilibrium pattern was evaluated through the centre of mass (CoM) and centre of foot pressure (CoP) displacements within the base of support (BoS).

RESULTS

Results showed a significant decrease of movement speed execution with obesity (≈-23%, $p<0.01$), with a strong increase of CoM displacement range towards the anterior BoS limits (≈+43%, $p<0.05$). There was also an important spatio-temporal desynchronization of the focal and postural components of the movement between the descending and ascending movements (Figure 1). The morphological discomfort generated by the fat pad disrupting hip flexion combined with the large body mass fraction of the trunk accounted for the decrease of movement velocity in obese patients. It is likely that the large trunk body mass fraction forwarded CoM displacement towards the BoS boundaries and increased the risk of falling. In addition to the biomechanical constraints, a sedentary lifestyle also contributed heavily to slow down ($p<.005$) the movement speed in obese patients.

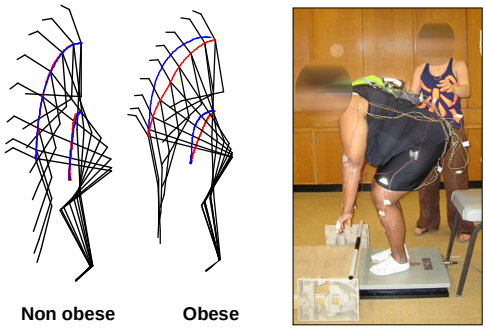

Figure 1. Kinematic of the movement for one non obese and one obese participant, representative of their respective groups. The CoM and shoulder pathway are shown in red for the descending movement and blue for the ascending movement. Note the forwarded CoM displacement toward the BoS boundaries for obese subject and his spatial desynchronization (CoM and Shoulder) between ascending and descending movement. Note also the decrease of hip and knee angular range of motion for obese subject.

CONCLUSION

The obese patients suffered from a slow movement speed during a task mobilizing the whole body. Associated to this decreased velocity, changes in the kinematics and equilibrium behaviour contributed to increase the risk of balance loss. These disorders appeared to be the result of a combination of biomechanical constraints, of physical activity lifestyle, and of other neurophysiological mechanisms specific to this pathology which must be determined more precisely in future studies.

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