Gait & Posture 46 (2016) 81–85

Contents lists available at ScienceDirect

Gait & Posture

journal homepage: www.elsevier.com/locate/gaitpost

Carrying shopping bags does not alter static postural stability and gait parameters in healthy older females

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ARTICLE INFO

Article history:
Received 11 July 2015
Received in revised form 16 February 2016
Accepted 24 February 2016

Keywords:
Ageing
Elderly
Functional tasks
Walking
Balance

ABSTRACT

Food shopping is an important aspect of maintaining independence and social interaction in older age. Carriage of shopping bags alters the body's weight distribution which, depending on load distribution, could potentially increase instability during standing and walking. The study examined the effect of carrying UK style shopping bags on static postural stability and gait in healthy older and young females. Nine older (71.0 ± 6.0 years) and 10 young (26.7 ± 5.2 years) females were assessed in five conditions carrying no bags, one 1.5 kg bag in each hand, one 3 kg bag in each hand, one 1.5 kg bag in preferred hand, one 3 kg bag in preferred hand. Antero-posterior and medio-lateral displacement, and 95% ellipse area from a 30 s quiet standing were used for postural stability assessment. Stride length and its coefficient of variation, total double support time, step asymmetry and gait stability ratio were calculated from 1 min treadmill walking at self-selected speed for gait assessment. Carrying shopping bags did not negatively affect postural stability or gait variables, in either group. Further, in older individuals, a decrease in sway velocity was found when holding bags during the postural stability assessment ($p < 0.05$), suggesting that carriage of bags, irrespective of the load distribution, may have a stabilising effect during quiet standing. These results should help to alleviate concerns regarding safety of carrying shopping bags and help encourage shopping, both as a social and as a physical activity.

1. Introduction

Being able to shop for food in later life is an important aspect of being independent and staying well. With more time at the older adults' disposal, shopping becomes a social activity as well as a daily necessity, with older individuals reporting spending extra time to meet friends, socialise and maintain their health [1].

Carrying the shopping bags home, however, may pose an additional challenge to the individual's postural stability during standing and walking, as the carriage of UK style shopping bags (Fig. 1) will impact on the centre of mass (CoM) location and behaviour during standing and locomotion. Initially, carrying the shopping bag would lower the centre of gravity, creating a more balanced stance. However, if this stance was disturbed, a torsion effect would be created, making recovery from the perturbation difficult. Similarly, when walking, the trunk sway experienced during normal gait may be exaggerated due to the (bilateral or unilateral) load carriage, further increasing the instability of the walk [2].

Notwithstanding the commonality of carrying shopping bags in everyday life, and its potential impact on stability and consequently falls in elderly, this area has not been previously researched. Previous studies utilised loads placed on the back (e.g. [3]) or the waist (e.g. [4]), positions which will affect the CoM differently to how the shopping bags would. Indeed, carrying a one-sided bag, such as a briefcase, a single-strap bag or purse, has been found to decrease lateral static postural stability in young individuals [5]. Such an effect, if also true for older individuals, could increase fall risk, as lateral instability impacts on the gait parameters associated with fall risk [6]. Further, carrying a shopping bag unilaterally, is very likely to impact on lateral instability [7] and more so during the single leg stance phase, as the individual's base of support is reduced while the centre of mass is 'shifted' laterally, again impacting on postural stability and gait and potentially, falling.

A consequence of falling, even if no injury occurs, is a fear of falling in the future. This fear of falling may limit the physical activities performed, and this reduction may in turn lead to reduced mobility and physical fitness which further increases risk

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http://dx.doi.org/10.1016/j.gaitpost.2016.02.017
0966-6362/

Fig. 1. Example of a UK style shopping bag, held unilaterally.

of falling [8]. The purpose of the present study, therefore, was to examine the hypothesis that carrying shopping bags can decrease static postural stability and have negative effects on gait parameters in older individuals.

2. Methodology

2.1. Subjects

Following ethical approval from the Institutional Ethics Committee, nine older (mean ± SD: aged 71.0 ± 6.0 years, age range: 68–75 years, body mass 66.3 ± 10.1 kg, stature 1.65 ± 0.06 m) and 10 young (mean ± SD: aged 26.7 ± 5.2 years, age range 22–31 years, body mass 70.2 ± 15.1 kg, stature 1.69 ± 0.05 m) healthy females agreed to participate in the study and provided written, informed consent. Participants were free of any injury for at least six months prior to testing and able to conduct daily activities independently and without the use of any aid.

2.2. Procedures

Participants were familiarised with the experimental set-up and testing took place on a single occasion. Height and weight were measured and both hands' handgrip strength was assessed with a handgrip dynamometer (Takei Scientific Inst. Co. Ltd., Niigata, Japan). Following this, participants were assessed (in a randomised order) on static postural stability and gait, performing five conditions for each assessment; no bags, one 1.5 kg bag in each hand, one 3 kg bag in each hand, one 1.5 kg bag in preferred hand only, one 3 kg bag in preferred hand only. The loads were chosen to represent the mass of typical food older individuals are likely to purchase, e.g. a loaf of bread (400/800 g), one can of soup (~300 g), 1 L of milk (~1 kg), etc., and their order was randomised.

2.2.1. Static postural stability assessment

Static postural stability was assessed with the participants standing quietly on a force platform (AccuPower, Advanced Mechanical Technology Inc., Watertown, Massachusetts) for 35 s, with the first five seconds discarded; thus, data were averaged over 30 s. Subjects were to stand in a natural stance, wearing their spectacles if required, focusing on a visual target placed approximately three metres in front of them at eye level and remain as motionless as possible. Data were sampled at 100 Hz (NetForce, Advanced Mechanical Technology, Inc., Watertown, Massachusetts) and antero-posterior and medio-lateral displacements, sway velocity and sway area (95% ellipse area), were calculated (BioAnalysis, Advanced Mechanical Technology Inc., AMTI, Watertown, Massachusetts). Sway velocity indicates the speed at which CoP adjustments are made. Sway area (95% ellipse area) indicates the amount of CoP movement and is a method used to estimate the confidence area of the CoP path where approximately 95% of the points on the COP path are enclosed in [9,10].

2.2.2. Gait assessment

Older subjects were allowed to walk for at least 20 min on the treadmill (Woodway PRO-27, Woodway, Waukesha, Wisconsin, USA) to establish their comfortable walking speed [11], which was then used for all trials. To assess gait, subjects walked on the treadmill for 2 min, with the last minute recorded for analysis. Stride length (and coefficient of variation), total double support (in seconds and percentage of the overall stride duration) and step asymmetry (deviation from equal duration steps between left and right limb) were measured using the Optojump Optical Measurement System (Microgate, Italy). Gait stability ratio (GSR, calculated as the ratio of cadence to velocity) was also recorded for each variable [12].

Heart rate was measured from the treadmill's sensors at the end of each condition, immediately after the subjects have stopped, and recorded. Each value was then converted to percentage of the age-predicted maximum heart rate (calculated as $208 - (0.7 \times \text{age})$) [13].

2.3. Data analysis

Normality of distribution was checked using the Shapiro–Wilk test and confirmed for all variables. A dependent *t*-test examined for handgrip strength differences between dominant and non-dominant hand, while an independent *t*-test was used to compare handgrip strength between the older and young group. Differences between groups and within loads in postural stability, gait and heart rate variables were examined with a 2 (group) × 5 (load) ANOVA. Only comparisons from significant main effects and interactions were further analysed and subsequently reported. Those were further examined by Mann–Whitney *U* test for differences between groups and repeated measures ANOVA, with dependent *t*-tests, if required, for differences between loads. Holm–Bonferroni correction was applied for multiple comparisons. Effect sizes (ES) were calculated for significant comparisons, with ES of 0.2, 0.5 and 0.8 indicating small, medium and large effects, respectively. An alpha level of 0.05 was used for all statistical comparisons. Data are given as mean ± standard deviation (SD).