INTRODUCTION

Obesity is a major health concern all over the world. One of the major concerns related to obesity is that it leads to increased risk of falls. It has been reported that individuals with obesity have a higher likelihood of falls in comparison to their non-obese counterparts. High risk of falls among individuals with obesity has been associated with several factors, such as muscle weakness, postural instability, and abnormal body mass distribution [1]. As falls are considered the most common cause of injuries in obese community, it is pressingly needed to develop an effective training paradigm which can reduce those aforementioned risk factors of falls.

Though training programs based on weight loss and strength training have been applied to reduce the risk of falls among individuals with obesity [2], they may not be suitable for the entire obese community. For example, a significant portion of individuals with obesity is unable or unwilling to comply with or manage conventional training regimens requiring high intensity and long duration. Therefore, alternative training approaches requiring less intensive physical activities involved to prevent falls targeting persons with obesity are highly demanded.

Controlled whole-body vibration training (CWBV) has recently emerged as a relatively novel modality to train older adults to reduce their fall risk [3]. It has been proven that a short-term (6-10 weeks) CWBV training course enhances neuromuscular performance and reduces risk of falls among older adults [4]. The transmission of mechanical vibrations and oscillations to the human body can lead to physiological and neuromuscular changes on numerous levels [5]. Some common risk factors of falls shared by older adults and individuals with obesity suggest that CWBV could be a promising approach to prevent falls in the stroke community. However, no study has investigated the potential effect of CWBV training on reducing falls among populations with obesity. Therefore, the primary purpose of this study was to systematically examine the overall effectiveness and feasibility of CWBV training in reducing risk of falls among individuals with obesity. We were particularly interested in studying the impact of a 6-week CWBV training on reducing body fat percentage, improving muscle strength, and enhancing dynamic gait stability.

METHODS

Five young adults (age: 26.2 ± 9.04 years; body height: 172.16 ± 4.43 cm; body mass: 100.18 ± 6.28 kg; 2 females) with obesity were recruited to participate in this preliminary study. Obesity level was determined based on both the body mass index (BMI ≥ 30 kg/m²) and the body fat percentage (≥ 30%). All subjects gave informed consent for participating in this study.

This study adopted a pretest-posttest design. All subjects received CWBV training 3 days a week for 6 weeks. The training was delivered by a vibration platform (Orthometrix, NY) in an intermittent way: each 1-min vibration was followed by a 1-min rest for 10 minutes when they stood on the platform. The vibration frequency was 25 Hz and the amplitude 7.8 mm. Immediately prior to (or pre-training) and following (or post-training) the 6-week CWBV training, each subject was evaluated for their risk of falls quantified in terms of the muscle strength, body fat percentage, and dynamic stability during walking.

Subjects’ knee joint extensor strength capacity was assessed under isometric condition on the right side
via an isokinetic dynamometer (Biodex, NY). The body fat percentage was measured by a bioelectric impedance analysis (BIA) machine (RJL-101, MI). To evaluate the dynamic gait stability, each subject was required to walk on a 12-m walkway at their preferred gait speed. Their full body kinematics was collected from 28 retro-reflective markers placed on the subjects’ body and floors by using an 8-camera motion capture system (Vicon, UK).

The body center of mass (COM) kinematics was computed using gender-dependent segmental inertial parameters [6] from the filtered markers paths. The two components of the COM motion state, i.e. its position and velocity were calculated relative to the rear of base of support (i.e. the leading heel) and normalized by foot length and $\sqrt{g \times bh}$, respectively, where $g$ is the gravitational acceleration and $bh$ the body height. The timing for two events in the gait cycle: touchdown (TD) of the leading foot and liftoff (LO) of the trailing foot, was identified from feet kinematics. The stability was calculated at both time instants as the shortest distance from the COM motion state to the limits of stability against backward balance loss [7].

Paired $t$-tests were used to compare all risk factors between the two evaluation sessions (i.e. pre-training vs. post-training) in order to determine the possible effect of the CWBV training. All statistics were performed using SPSS 19.0 (IBM, NY), and a significance level of 0.05 was used.

RESULTS AND DISCUSSION

The 6-week CWBV training significantly improved the maximum isometric knee extensor strength among the obese adults in this study. Specifically, the maximum knee extensor strength increased to $1.83 \pm 0.23$ Nm/kg in the post-training evaluation from $1.66 \pm 0.28$ Nm/kg in the pre-training evaluation ($p < 0.05$). Similarly, the dynamic gait stability was improved as the result of the vibration training. In detail, the stability values were $0.61 \pm 0.02$ and $0.32 \pm 0.06$ respectively for TD and LO before the training. The stability at TD and LO became $0.70 \pm 0.05$ ($p < 0.01$) and $0.40 \pm 0.03$ ($p < 0.05$), respectively post the training.

Interestingly, the body fat percentage did not show difference between two evaluations ($37.45 \pm 7.40$ vs $37.45 \pm 7.65$, $p > 0.05$). One explanation for this could be that the 6-week CWBV training actually does not affect body composition. Alternatively, the small sample size or the accuracy level of the BIA machine employed in this study could also contribute to the similar body fat percentage between tests. The stability examined in this study was the one against backward falling. Therefore, it remains unknown how CWBV training affect the stability against balance loss in other directions. These warrant our further investigation.

CONCLUSIONS

A 6-week CWBV training course can increase muscle strength and improve dynamic gait stability control among young obese adults. As these two factors closely relate to falls, CWBV training could serve as a promising training method to reduce fall risk among individuals with obesity. However, it may not change the body composition at least in the sample studied in this experiment. Still, the finding from this study sheds light on the feasibility of applying CWBV training to reduce falls among individuals with obesity.

REFERENCES


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