Exercises on a Sand Surface could Significantly Improve Walking Ability of Elderly After 3-week Training: A Randomized Control Trial

การออกกำลังกายบนพื้นทรายพัฒนาความสามารถด้านการเดินในผู้สูงอายุได้หลังการฝึก 3 สัปดาห์: การวิจัยเชิงทดลองแบบสุ่มและมีกลุ่มควบคุม

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ABSTRACT

Current methods to promote level of independence and health status of elderly likely involve various types of exercises on a hard surface. Several studies have reported challenging effects of a sand surface, without clear evidence to support its benefit over a hard surface. This study compared effects of 6-week exercise training on hard and sand surfaces on walking ability in 30 community-dwelling elderly using a randomized control trial with double-blinded design. The subjects (with an average age of 73 years, mostly female) were trained using a Thai dance program on hard (n=15) or sand (n=15) surface for 50 minutes/session, 3 times/week over 6 weeks. Subjects were assessed for their walking ability using the 10-meter walk test (10MWT) before the training, and after the 3rd and the 6th week of training programs. The results indicated that exercises on a sand surface significantly improved walking ability of the subjects after 3 weeks, and the effects were continued to after 6 weeks. As outcomes of the 10MWT are important for overall walking ability, health status and levels of independence for elderly, the incorporation of a sand surface into a training program may promote rehabilitation outcomes of elderly, particularly in a current era that the number of these individuals is dramatically increased.

บทคัดย่อ

ปัจจุบันการส่งเสริมความสามารถและภาวะทางสุขภาพของผู้สูงอายุมักใช้การออกกำลังกายแบบต่างๆ บนพื้นแข็ง การศึกษาจำนวนมากได้รายงานผลของพื้นทรายโดยไม่มีหลักฐานสนับสนุนประโยชน์ของการออกกำลังกายบนพื้นทรายที่เหนือกว่าพื้นแข็งอย่างชัดเจน การศึกษานี้เปรียบเทียบผลของการออกกำลังกาย 6 สัปดาห์บนพื้นแข็ง และพื้นทรายต่อความสามารถด้านการเดินในผู้สูงอายุที่อาศัยในชุมชนจำนวน 30 ราย โดยใช้การวิจัยเชิงทดลองแบบสุ่มและมีกลุ่มควบคุมโดยการปิดบัง 2 ทาง อาสาสมัคร (อายุเฉลี่ย 73 ปี ส่วนใหญ่เป็นเพศหญิง) ได้รับการฝึกรำไทยบนพื้นแข็ง (15 คน) และพื้นทราย (15 คน) เป็นเวลา 50 นาที/ครั้ง 3 ครั้ง/สัปดาห์ ทั้งหมด 6 สัปดาห์ อาสาสมัครได้รับการประเมินความสามารถด้านการเดินโดยใช้ 10-meter walk test (10MWT) ก่อนการฝึก และหลังการฝึกสัปดาห์ที่ 3 และ 6 ผลการศึกษาบ่งชี้ว่าการออกกำลังกายบนพื้นทรายช่วยพัฒนาความสามารถด้านการเดินเมื่อทดสอบด้วย 10MWT มีค่าเพิ่มขึ้น หลังการฝึกในสัปดาห์ที่ 3 และมีค่าเพิ่มขึ้นต่อเนื่องหลังการฝึกในสัปดาห์ที่ 6 เนื่องจากผลลัพธ์ของการทดสอบ 10MWT มีความสำคัญต่อความสามารถด้านการเดิน โดยรวม ภาวะทางสุขภาพ และระดับการช่วยเหลือตนเองของผู้สูงอายุ ดังนั้น การนำพื้นทรายมาร่วมในโปรแกรมการฝึกอาจช่วยส่งเสริมผลลัพธ์ของการฟื้นฟูความสามารถให้ดีขึ้น โดยเฉพาะในปัจจุบันที่จำนวนผู้สูงอายุเพิ่มขึ้นอย่างชัดเจน

Keywords: Exercise, Rehabilitation, Walking
คำสำคัญ: การออกกำลังกาย การฟื้นฟูความสามารถ การเดิน

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Introduction

Advancing age likely accompanies the body system decline that affect walking ability, levels of independence, health problems, and safety issue of elderly (Hebert et al., 1999; Russell et al., 2006). Current managements for these problems commonly involve various types of exercises, such as aerobic exercise, yoga, Tai Chi, Otago exercise, social dance, and traditional dance on a hard surface (Tiedemann et al., 2013; Galantino et al., 2012; Ni et al., 2014; Sherrington et al., 2008; Taylor et al., 2012; Merom et al., 2013; McKinley et al., 2008) Such exercises have been verified for their effectiveness in elderly, but after rather long training duration (8-12 weeks).

From literature review, the researchers found challenging effects of a sand surface on physical activity that may be applicable to improve walking ability, levels of independence, and health status of elderly (Miyama and Nosaka, 2004; Giatsis et al., 2004). However, there was no clear evidence to confirm its benefit over a hard surface. The researchers hypothesized that exercises on a sand surface put a high demand on ability of elderly; thus they could improve walking ability within a short training period. The findings may offer an alternative rehabilitation strategy for community-dwelling elderly.

Objectives of the study

To compare effects of exercise training on a hard or sand surface over 6 weeks in community-dwelling elderly.

Methodology

Subjects

This study was a randomized controlled trial with subjects- and assessor-blinded design in elderly, aged at least 65 years, from several communities in the northeast areas of Thailand. The inclusion criteria were ability of independent walking over at least 10 meters without any assistive devices. The exclusion criteria were any signs and symptoms that might affect participation in the study, i.e. unstable medical conditions, inflammation in the joints of the lower extremities (with a pain scale>5 out of 10 on a visual analog scale), having sequelae of neurological deficits or other conditions that might affect ambulatory ability. Subjects signed an inform consent document prior to participation in the study. The research protocol of this study was approved by the Human Research Ethics Committee, Khon Kaen University based on the Declaration of Helsinki and Good Clinical Practices (HE 602099).

Research protocols

The eligible subjects were randomly arranged into a training group using age and gender. They were interviewed and assessed for their baseline demographics and functional ability. Then they were trained using a group exercise of Thai dance program on a hard (control group) or sand (experimental group) surface for 50 minutes/session, 3 times/week, for 6 weeks, and the outcome of the study was repeatedly measured at 3 and 6 weeks after training. The Thai dance program was applied because it is a part of the traditional art and culture of Thai people that is characterized by coordinated, slow-to-moderate continuous movements of the whole body according to the rhythm of the music used (Khongprasert et al., 2012). Thus it was familiar by the subjects and helped to control

movement rhythms of the subjects in both groups. In addition, the program has already been verified for its effectiveness over 6-week training (Janyacharoen et al., 2013). Details of the training programs and outcome assessments are as follows.

Exercise program on a sand surface (experimental group)

The Thai dance exercise with a moderate rhythm of the songs (Sot Soi Mala, Chak Paeng Phat Na, Ram Sai, Ram Yua, Phrom Si Na, Yung Fon Hang, Chang pra san nga, Chan Song klot, Cha ni rai mai, Khat Chang Nang and Lo Kaeo) was performed over dry soft sand. In each session, subjects performed the dance without shoes with a session of warm-up and cool-down over 10 minutes/session before and after training, respectively (Morrison et al., 2009; Yan, 1998). Thus, the total program lasted 50 minutes/session as led by a video to promote standardization of dance program for both groups.

Exercise program on a hard surface (control group)

Subjects were involved in a program as that explained for the experimental group, but on a hard smooth level surface.

The training program for sand and hard surfaces was executed as group exercise without shoes, separately in each community in order to blind the subjects from the other training program. During training, the researcher was always beside the subjects without interruption to ensure their safety. Data of any subjects who completed the training program less than 80% of all sessions (or 15 out of 18 training sessions) were excluded from data analysis.

Outcome measure

Subjects were assessed for the outcomes of the study using the 10-meter walk test (10MWT). Outcomes of the test reflects walking speed that associates with overall walking quality, ability of community participation, health status, levels of independence, morbidity, and mortality rate of elderly (Cesari et al., 2005; Hardy et al., 2007; Studenski et al., 2011; Finch et al., 2002; Duncan et al., 2003; Yoshimoto et al., 2015; Thaweewannakij et al., 2016). The test required subjects to walk along a 10m walkway at a comfortable speed for 3 trials, and the time was recorded during the 4m in the middle of the walkway by a blinded assessor (Suwannarat et al., 2015; Eden et al., 2017). During the test, subjects wore a proper size, sandal sport shoes that were prepared by the researchers with a practice session until they were familiar with the shoes. A tester was always beside the subjects to ensure their safety and accuracy of the outcomes. Then, the average findings over the three trials were used for data analysis.

Statistical analysis

Descriptive statistics were used to describe personal characteristics of the subjects and findings of the study. The analysis of variance (ANOVA) with repeated measures was used to compare effects of exercise training among the 3 measurement times within the groups. Then the post-hoc (Bonferroni) was used to indicate the significant difference in each pairwise comparison. With no significant difference of baseline data, the independent samples t-test was used to compare the outcomes between the groups after weeks 3 and 6. The level of significant difference was set at p-value < 0.05.

Results

Thirty subjects (15 subjects/group) completed the study. Their personal data and baseline walking ability showed no significant difference between the groups (Table 1 and Figure 1).

After 3-week training, subjects in an experimental group showed significant improvement of the 10MWT from 1.17±0.17 m/s prior to training to 1.28±0.18 m/s (p<0.01) at 3 weeks after training. Then the data were further improvement to 1.42±0.19 m/s, p<0.01) after 6 weeks (Figure 1). For the control group, the significant improvement was also found, but at 6 weeks after training (p<0.05, Figure 1) (the 10MWT data = 1.07±0.12 m/s, 1.17±0.16 m/s, and 1.20±0.19 m/s for weeks 0, 3 and 6, respectively).

Table 1 Subjects' demographics (n = 30)

Variable	Hard surface (n = 15)	Sand surface (n = 15)	*p*-value
Age (year)	74.50±5.90	72.20±3.96	0.157
Gender : women/men (n)	10/5	8/7	0.546
Weight (kg)	56.91±7.69	57.38±6.21	0.845
Height (cm)	154.79±7.37	157.56±7.05	0.303
Body mass index (kg/m^2)	23.85±3.52	23.11±2.11	0.492

Notes: Data are presented using mean ± standard deviation, and compared between the groups using the independent samples t-test for continuous data and Chi-square test for the categorical data.

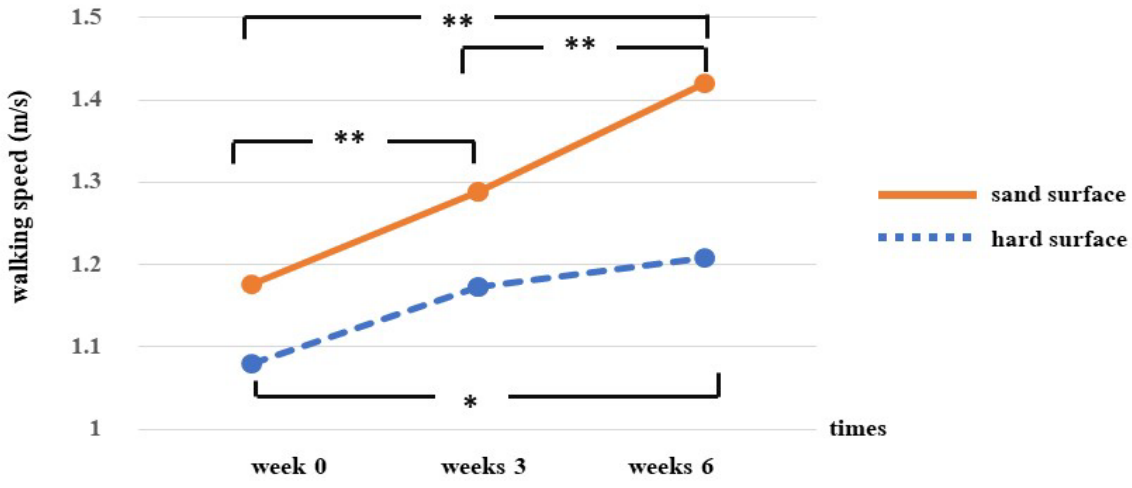

Figure 1 Data of the 10-meter walk test of the subjects at weeks 0, 3 and 6

Notes: **indicated significant difference with p< 0.01, *indicated significant difference with p< 0.05 as analyzed using the analysis of variance (ANOVA) with repeated measures and the post-hoc test (Bonferroni).

Discussion and Conclusions

This study compared effects of exercise training on hard and sand surfaces on walking ability of elderly. The findings indicated that the Thai dance exercise on sand surface could significantly improve walking ability of the subjects since 3 weeks, and continued to 6 weeks after training ($p<0.01$, Figure 1), while those who exercised a hard surface showed significant improvement of the outcomes only 6 weeks after training ($p<0.05$, Figure 1). The improvement in the control group suggest benefit of Thai dance exercise that required the subjects to step forward and backward repeatedly while raising and lowering the body over the extended and bending of a single and double limb support period of the lower extremities for 30 minutes (Khongprasert et al., 2012). The moderate rhythms of the songs also guided the subjects to maintain their movement speed according to the rhythm used. However, the obvious improvement in an experimental group may further suggest the challenging effects of the sand over the hard surfaces. Shifting nature of the sand provided unstable surface and the soft area reduces work proficiency of the muscles (Miyama and Nosaka, 2004; Pinnington et al., 2005; Impellizzeri et al., 2008). Such characteristics challenged balance ability, lower limb muscle activity, and energy expenditure of the subjects (Lejeune et al., 1998; Morrison et al., 2009). Then, repetitive practice on the sand surface could significantly increase data of the 10MWT at 3 weeks, and the effects were also further demonstrated at 6 weeks after training (Figure 1).

The improvement of the 10MWT is important because it is commonly used to reflect health status, level of independence, and ability of community participation of elderly. Outcomes of the test reflect walking speed that has been reported for many cutoff points for health-related outcomes (Studenski et al., 2011), and the improvement of walking speed at 0.10 m/s is regarded as having clinical significance (Perera et al., 2006). The current findings suggested that after 3-week training on a sand surface, the subjects could improve their walking speed of 0.25 m/s which was meaningful difference for elderly.

The current findings were clinically meaningful because a sand area is available in communities, and the incorporation of a sand surface may promote outcomes of rehabilitation for community-dwelling elderly. Nonetheless, the findings were confirmed only for the 10MWT without data collection over a retention period. Thus the findings cannot thoroughly verify for all functional needed for levels of independence and learning effects of elderly. Thus, a further study should investigate other aspects relating to benefit of sand exercise with the assessments over a retention period to confirm clinical utility of sand surface on rehabilitation practice for community-dwelling elderly.

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