REACTION TO A LOSS OF BALANCE IN HEALTHY MENOPAUSAL-AGED AND YOUNG WOMEN

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INTRODUCTION

Falls and fractures related to those falls are a significant problem in elderly adults [1]. Epidemiological studies have also shown that there is a greatly increased risk for distal forearm fracture in women that are not elderly, but experiencing menopause [2]. Osteoporosis cannot explain why other fracture sites do not show the same increase in fracture rate [3] or why these women are also falling much more frequently than their younger counterparts [4].

This is a pilot study designed to determine the reaction of menopausal-aged women, MW, to a fall situation (balance disturbance) and compare that reaction to those of younger women, YW. It is hypothesized that the menopausal-aged women will have slower arm reaction time, RT, than the younger women in an actual balance disturbance and that the older women would have slower movements while attempting to regain their balance with their arms. Most previous work has focused on differences between young women and those over the age of 65 and only a few studies have looked at reactions to actual fall conditions or at upper extremity reactions to these conditions [5].

METHODS

Three healthy young women and three healthy menopausal-aged women were recruited from the Elizabethtown College community. The young women had a mean age of 20 ± 1 years and the menopausal-aged women had a mean age of 50 ± 1 years. Subjects were screened by a written health evaluation, signed an informed consent form, and all procedures were approved by the institutional review board.

Subjects were asked to step onto a balance disturbance platform, with hands at their sides, wrists contacting switches placed at their hips. Each was fitted in a safety harness to prevent any fall to the ground and told to try to keep her feet in place at all times, but that she was free to move her hands. Subjects were asked to react as naturally as possible to any loss of balance that may happen during the study. The electronic switches captured timing data and arm movements were recorded by two Sony digital cameras and a SIMI motion capture system (SIMI Reality Motion Systems, Germany).

Twenty trials were conducted with the YW at multiple drop heights (up to 8.25 cm) to determine a minimum effective balance disturbance. With this determined, ten trials were conducted with the MW at this height.

The hypothesis was tested in using a student t-test assuming unequal variance. Two-tailed t-values below .05 were considered significant. RT's that were more than 4 stdev from the mean of the other trials for that subject were discarded as outliers (3 instances).

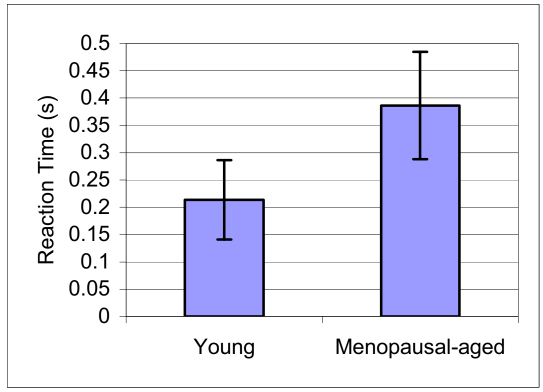

Figure 1: Average reaction time for the two groups.

RESULTS AND DISCUSSION

There was no relationship between trial number and RT in the YW and MW and that there was no relationship between drop height and RT in the YW ($r < 0.5$ for all subjects).

The YW and MW responses at the minimum effective balance disturbance (5.7 cm drop) showed YW reacted with a mean RT of 214 ± 73 ms and MW reacted with a mean RT of 386 ± 98 ms. A trend is noticeable, as shown in figure 1, but there is not a statistically significant difference with the limited number of subjects here ($p = 0.08$). The YW reactions times were just faster than those reported in slips while walking (250 – 300 ms) [5]. The movements themselves were very similar between YW and MW, table 1.

This data, though limited, suggests a potential decline in the ability to respond to a fall disturbance as early as at 50 years of age in women. However, surprisingly, the velocity and magnitude of the responses appears essentially unchanged.

	YW	MW
Movement amplitude (m)	0.12 ± 0.07	0.17 ± 0.12
Maximum velocity (m/s)	1.3 ± 0.5	1.2 ± 0.7

Table 1: Average movement measurements.

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