

INTRODUCTION

- Increased body mass index (BMI) is associated with decreased postural stability, as measured by center of pressure (COP) displacements and velocities during quiet stance [1,2] and has been associated with an increased risk of fall-related injury.[3].
- Only one *retrospective* study has reported a higher fall rate in obese adults compared to normal weight subjects (27% vs. 15%) and a higher rate of stumbles [4].
- The primary **purpose** of this study was to determine if obese women age 55+ years have a higher fall-risk than a group of normal weight women.
- In particular, when compared to normal weight women:
 - Q1. Do obese women report a greater rate of *retrospective* falls and are these rates comparable with those of Fjeldstad et al [4]?
 - Q2. Do obese women report a greater rate of falls and stumbles when monitored *prospectively*?
 - Q3. Do obese women fall more often following a laboratory-induced fall and are the mechanisms of recovery different?

METHODS

The current study was a secondary analysis of data from two larger studies of the influence of a fall prevention intervention on falls both in the laboratory and in the community. Subjects were community dwelling women, 55+ years old and screened for exclusion criterion including the presence of neurological, cardiovascular, pulmonary or musculoskeletal impairments. Only the data of women assigned to the control group (no intervention) are reported.

Study 1

- Subjects (35 normal weight (18.5≤BMI≤25) and 31 obese (BMI≥30)) reported the number of falls during the previous 12 months ("retrospective falls", Figure 1).
- Subjects communicated (postcards/telephone) the occurrence of falls and stumbles every two weeks ("prospective falls/stumbles", Figure 1).
- Responses from subjects who recently completed six months of the prospective study were included in the analysis (14 obese and 16 normal weight, Figure 1).
- The percentage of subjects reporting retrospective falls and prospective fall/stumble was determined.
- For Q1 a Fisher's exact test was used to determine whether there was a non-random association between obesity and retrospective falls.
- For Q2 the relative risk (RR - see below) and its 95% confidence interval (CI) were used to determine the association between obesity and prospective falls/stumbles. If the CI included the value 1.0 then the risk for falling/stumbling was considered equally likely for the two groups. A Fisher's exact test was run to further test for significance.

$$RR = \frac{(\% \text{ obese experiencing event})}{(\% \text{ normal weight experiencing event})}$$

Study 2

- 25 subjects (13 normal weight and 12 obese) wore an instrumented safety harness and walked over an 8m laboratory walkway.
- Trips were induced using a concealed obstacle which rose from the floor when manually triggered [5].
- The occurrence of a fall was defined if >50% of a subject's body weight was registered by the harness (Figure 2)
- A motion capture system (Motion Analysis, Santa Rosa, CA) recording at 120 Hz collected the positions of 22 passive reflective markers from which the following kinematics of the trip were calculated:
 - reaction time (time from trip initiation to recovery step completion)
 - recovery step length
 - trunk flexion angle and trunk angular velocity at recovery step completion
- For Q3 a Fisher's exact test was used to determine whether there was a non-random association between obesity and falls in the laboratory.

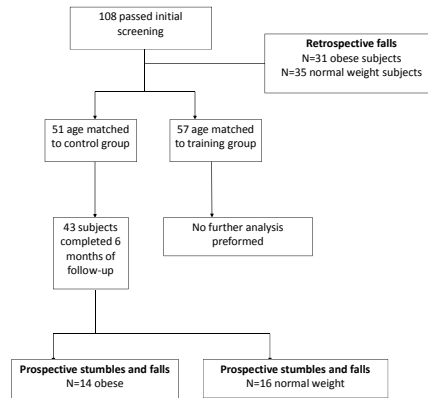


Figure 1. Flowchart summarizing participant recruitment and inclusion in Study 1



Figure 2. (left) In Study 2, subjects walked while wearing a full body safety harness. A pneumatic obstacle was triggered to rise from the laboratory floor and obstruct the motion of the foot of the swing limb (right). Four of five obese fallers, became fully supported by the harness before the recovery limb was able to complete the step (right). Kinematics at recovery step completion could not be calculated for these fallers. All normal weight subjects were able to complete the recovery step.

RESULTS

Study 1

- 15/31 obese women reported falling during the previous year vs. 15/35 normal weight women. (p=0.42).
- Over the six month prospective period, 5/14 obese women reported falling vs. 6/16 normal weight women. (RR=0.95, p=0.61).
- Over the same period 2/14 obese women reported stumbling vs. 6/16 normal weight women (RR=0.38, p=0.16).

Study 2

- 3/12 and 5/13 normal weight and obese women, respectively, fell following the laboratory induced trip (p=0.29).
- Recovery was associated with a longer step length, smaller trunk flexion, and larger trunk extension velocity at recovery foot strike in both normal weight and obese subjects (Figure 3)
- Falls were associated with larger trunk flexion angle and trunk flexion velocity at recovery step completion in both obese and normal weight subjects.

	Obese (%)	Normal weight (%)	Risk ratio	95% CI on RR
Laboratory trips	38.5	23.0		
Retrospective falls	35.5	42.9		
Prospective falls	35.7	37.5	0.95	0.37-2.45
Prospective stumbles	14.3	37.5	0.38	0.09-1.59

Table 1: Summary of results from Study 1 and Study 2

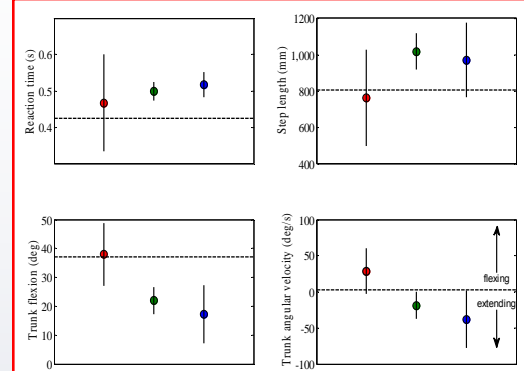


Figure 3. Reaction time (top left), step length (top right), trunk flexion angle at recovery step completion and trunk angular velocity at recovery step completion (bottom left and right, respectively) after laboratory-induced trip for normal weight fallers (red), one obese after-step faller (dotted line), normal weight non-fallers (green) and obese non-fallers (blue). Means ± 95% CI. Mechanisms of recovery are similar between groups, as are mechanisms of failure for those who completed the recovery step.

DISCUSSION

- We show, for the first time, that obese women 55+ years are not at increased risk of experiencing a fall or stumble. This is based on a prospective study which may be more reliable than retrospective reports [6].
- The rate of prospective falls for each group was consistent with studies reporting ~30% of older adults fall yearly [7].
- The rate of retrospective falls reported in this study differ from those of Fjeldstad [4] who reported falls by 27% of obese and 15% of normal weight subjects. This may be due the following subject characterizations in that study:
 - Inclusion of males and subjects under 55 years old affect the overall observed rates of falls
 - 13% of obese subjects were diabetic, compared with 4.5% of normal weight subjects, which could increase the rate of obese fallers. None of our women were diabetic.
 - Obese subjects were significantly older which may have influenced the rate of falls in this group.
- The above differences, in addition to the prospective nature of our data collection, may also explain the higher rate of stumbles reported by obese vs. normal weight subjects (32% vs. 14% respectively) [4].
- Increased BMI did not appear to interfere with the mechanisms of recovery after a laboratory-induced trip. However, most obese fallers did not complete the recovery step before falling. Since, even for fallers, this step likely aids in decelerating the bodies' acceleration, a non-stepping recovery response could increase impact force and the chances of injury.
- Although we report no significant increase in fall risk for obese women age 55+, the relatively small sample size and the secondary nature of the data analysis suggests that additional study may be prudent. However, the fact that outcomes of prospectively reported falls and stumbles, retrospectively reported falls and laboratory-induced trips agree, suggests our findings may still be robust.

Conflict of Interest: There was no conflict of interest associated with this research project. Supported by R01 CE001430 and R49CE000620

References

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