Age and Sex Associations for Incident and Recurrent Falls from 1992-2016: A Cross-Cohort Analysis in Older Adults

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INTRODUCTION

- Falls occur in 25-30% of older adults each year
- Mortality from fall injuries increased substantially in the past decades: highest increases at the oldest ages and in men
  - Uncertain patterns for falls and recurrent falls over this time

OBJECTIVE

- To describe any falls, recurrent falls and number of falls by sex and age-groups over 25 years in women and men

METHODS

1. **Cross cohort population for 4 U.S. longitudinal cohorts**
   - 22,471 women and men, aged 64 to 104 years (56% women: 67% White, 77±7 years; 44% men: 85% White, 74+6 years) at baseline, data from 1992-2016
     - Cardiovascular Health Study (CHS): 5,888 women and men (65+ years) at 4 sites, from 1992-2005
     - Health, Aging, and Body Composition Study (Health ABC): 3,075 ambulatory women and men (70-79 years) at 2 sites, from 1997-2009
     - Osteoporotic Fractures in Men Study (MrOS): 5994 ambulatory men (65+ years) at six sites, from 2000-16
     - Women's Health Initiative Long Life Study (WHI-LLS): 7,868 women (63-93 years) at 40 sites from 2012-16
2. **5-year age groups by sex**
   - 64-69 (ref) vs. 70-74, 75-79, 80-84, 85-89 and ≥90 years
3. **Annual self-reported fall outcomes**
   - Assessed over the past year for 25 years, including:
     - any incident fall (0 vs. 1)
     - recurrent falls (0/1 vs. ≥2)
     - number of falls (0, 1, ≥2)

STATISTICAL ANALYSES

Univariate analysis: t-test and Wilcoxon rank-sum, or Chi-square by sex **(Table 2)**

Multivariate analysis:

- Logistic regression for baseline outcomes (**Table 1**)
- Any incident fall and recurrent falls outcomes: Multivariable Generalized Estimating Equations (GEE) with a binomial logit link estimated ORs
- Number of falls outcome: Multinomial cumulative logit link ORs
- Age*sex interactions significant (p<0.05) for all outcomes so models were stratified by sex
- Block entry and removal of variables at α>0.1(**Table 2**): demographic factors, including time-varying age-groups, and time-varying lifestyle variables (All final models adjusted for variables in Figure 1 footnote)

Results Summary

- For recurrent falls (**Figure 1**), adjOR were higher up to 85-89 vs. 64-69 years, but at >90 years were non-significant in women (OR=0.86, 0.69-1.10) and lower in men (OR=0.79, 0.70-0.90), with no major attenuation from covariates.
  - Men had generally higher adjOR for fall outcomes vs. women at each age group, though with similar trends
  - Directionality differed from baseline ORs at ≥90 years (**Table 1**)
- Results consistent for incident falls and number of falls for baseline and longitudinal models

Table 1. Adjusted baseline fall OR (95%CI), overall by age group (years) v. 64-69 years

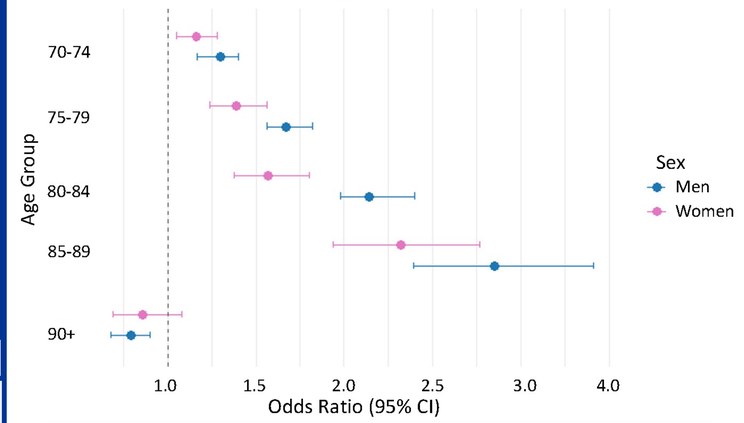
Baseline outcomes, n=22,471	70-74 n=7342	75-79 n=5402	80-84 n=3836	85-89 n=2011	≥90 n=531	Overall p-value
Any Falls (Y/N)	1.1 (0.9,1.3)	1.4 (1.1,1.7)	1.6 (1.3,2.0)	1.8 (1.4,2.2)	2.3 (1.6,3.2)	<.0001
Recurrent Falls (Y/N)	1.0 (0.8,1.4)	1.5 (1.1,2.0)	1.4 (1.0,1.9)	1.4 (1.0,2.0)	2.7 (1.7,4.3)	<.0001
Number of Falls (0,1,2+)	1.1 (0.9,1.3)	1.4 (1.1,1.7)	1.5 (1.3,1.9)	1.7 (1.4,2.1)	2.4 (1.7,3.3)	<.0001

Table 2. Baseline descriptive characteristics: overall and women vs. men*

Mean(SD) or %	*Overall N=22,471*	*Women N=12,711*	*Men N=9,760*
Age, years	75.96 (6.33)	77.40 (6.53)	**74.08 (5.51)**
Race/ethnic groups: White	75	67	**85**
Black/African American	23	31	12
Other	2	1	3
Education: <HS	14	13	**14**
HS grad	24	25	22
Post-secondary	63	62	64
Height, mm	1656.08 (99.09)	1593.06 (69.48)	**1737.07 (67.62)**
Weight, kg	75.74 (15.60)	70.87 (15.52)	**82.03 (13.28)**
BMI, kg/m^2	27.58 (5.03)	27.92 (5.76)	**27.16 (3.87)**
Waist Circumference, cm	95.70 (13.86)	92.84 (14.50)	**100.48 (11.19)**
Physical Activity, sd/week	0 (1)	-0.03 (0.99)	**0.03 (1.01)**
Alcohol intake: None	40	41	**39**
Less than once a week	24	31	15
One or more per week	36	28	46
Smoking Status: Never	45	54	**34**
Current	6	7	5
Former	45	35	58
Falls, yes	24	28	**19**
Recurrent Falls, yes	9	10	**8**
Number of Falls: None	76	72	**81**
1	14	17	11
2+	9	10	8

Bold *P<0.001 for women vs. men using t-test, Wilcoxon rank-sum, and Chi-square tests

Figure 1. OR by sex and 5-year age group (ref: 64-69 yrs) for recurrent falls, 1992-2016: n_{obs}=43,670 women and 67,875 men



Final models adjusted for cohort indicator: CHS, Health ABC, MrOS, WHI-LLS, race: White, Black, and other; education: <HS, HS, >HS; and time-varying: 5-year age-groups; BMI: kg/m^2; and standardized physical activity/week: SD. Smoking: never/former/current, and drinking: none, <1/week, ≥1 week were not significant and dropped from final models.

STRENGTHS

- Large longitudinal cross cohort study of 4 U.S. aging cohorts
- Women and men examined separately
- Fall outcomes over 25 years, adjusted for time-varying covariates

LIMITATIONS

- Fall injury data was not harmonizable across cohorts
- Additional covariates will be examined in the future

CONCLUSIONS AND FUTURE DIRECTIONS

- Prospective fall outcomes vs. cross-sectional data are critical to understanding risk as an individual ages and for fall prevention
- Future plans to further examine mortality competing risks in the oldest participants and link CMS claims for fall injuries

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