Mortality From Falls in Dutch Adults 80 Years and Older, 2000-2016

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Letters

RESEARCH LETTER

Mortality From Falls in Dutch Adults 80 Years and Older, 2000-2016

Falls are a leading cause of health care consumption, morbidity, and mortality among older adults.[1,2] Falls mortality in persons 80 years and older in the Netherlands decreased from 1969 through 1999, and then slightly increased from 2000 through 2008.[3] We assessed trends in falls mortality in persons 80 years and older from 2000 through 2016.

Methods | The institutional review board (Erasmus MC, University Medical Center Rotterdam) waived the need for informed consent. Statistics Netherlands is a nationwide, statutory institute, which manages the Official Cause-of-Death Statistics.[4] Data on unintended deaths from falls of persons 80 years and older were collected from 2000 through 2016. We had access to underlying (primary) cause-of-death data, as determined by Statistics Netherlands following the international coding rules of the World Health Organization. An unintentional fall was defined using the *International Classification of Diseases, 10th Revision* (*ICD-10*; codes W00-W19).

Numbers of deaths from falls were specified for age and sex. Crude mortality rates were calculated. Age-specific mortality rates were calculated in 5-year age groups (80-84, 85-89, 90-94, and ≥95 years) for men and women. Age-adjustment was done by direct standardization to correct for demographic changes throughout the study and mortality rates were expressed as cases per 100 000 persons 80 years and older. The mid-year population was used as the denominator for each year of the study. To model the trend in falls mortality, a regression model with Poisson error and log link was used. This model gives evidence of increasing linear trends, stable trends over time, or decreasing trends. A 2-sided *P* value of less than .05 was considered statistically significant. Statistical analyses were performed using SPSS Statistical Data software (IBM), version 17.0.0.

Results | From 2000 through 2016, an increase in the total number of deaths from falls in Dutch persons 80 years and older was seen (from 391 deaths in 2000 to 2501 in 2016) (**Table**). The overall crude mortality rate per 100 000 population increased from 78.1 (95% CI, 70.4-85.9) in 2000 to 334.0 (95% CI, 320.9-347.1) in 2016 ($P < .001$). Age-adjusted mortality rates per 100 000 persons in those 80 years and older increased significantly from 110.3 (95% CI, 90.9-129.6) in 2000 to 356.5 (95% CI, 333.2-379.8) in 2016 for men ($P < .001$) and from 91.6 (95% CI, 80.6-102.6) in 2000 to 380.5 (95% CI, 361.8-399.1) in 2016 for women ($P < .001$) (**Figure**). The age-specific mortality rates increased throughout the study period with age and for both men and women (Table).

Discussion | A reduction in falls mortality rates in persons 80 years and older in the Netherlands was reported from 1969 through 1999,[3] but this study found an increase from 2000 through 2016.

A strength of the study is the availability of reliable and valid data on unnatural causes of death.[4] The *ICD-10* codes were used throughout the study period, with a validity of 85% to 90%. In the Netherlands, all deaths due to accidents, suicide, and violence are assessed and confirmed by forensic specialists of the municipality using a standard procedure that remained unchanged from 2000 through 2016. However, no information was available on the falls history, circumstances, or risk factors such as comorbidity or polypharmacy. Furthermore, it is not known if the results are generalizable to other populations.

Multiple factors might have contributed to increased falls and falls mortality. Improved awareness and reporting of falls as an underlying cause of death could have contributed to at least part of the increase.[5] In addition, older people are living longer, living longer independently, and are generally more active compared with previous generations, perhaps increasing their risk of falls. Multimorbidity may have increased, leading to an increased fall risk.[6] Multimorbidity and the ensuing polypharmacy might also increase the risk for more serious fall-related injuries. New studies should explore reasons for the recent increase in falls mortality in persons 80 years and older.

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Author Contributions: Dr Hartholt had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.
Concept and design: All authors.
Acquisition, analysis, or interpretation of data: All authors.
Drafting of the manuscript: Hartholt, van der Cammen.
Critical revision of the manuscript for important intellectual content: Van Beeck, van der Cammen.
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Administrative, technical, or material support: van der Cammen.
Supervision: Van Beeck.

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1. Kannus P, Parkkari J, Koskinen S, et al. Fall-induced injuries and deaths among older adults. *JAMA*. 1999;281(20):1895-1899.

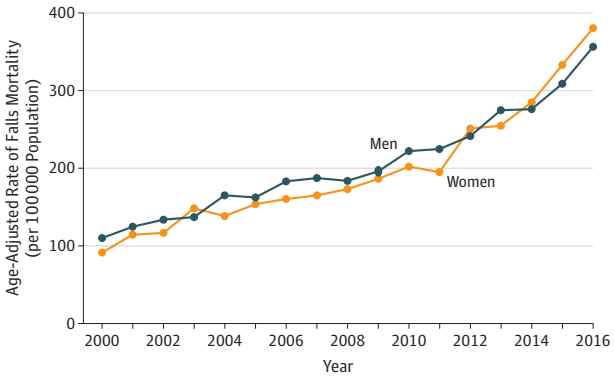
Table. No. and Rates of Falls Mortality in Persons 80 Years and Older in the Netherlands, 2000-2016[a]

	2000		2004		2008		2012		2016	
	No. of Deaths/ Population	Rate per 100 000 Population (95% CI)	No. of Deaths/ Population	Rate per 100 000 Population (95% CI)	No. of Deaths/ Population	Rate per 100 000 Population (95% CI)	No. of Deaths/ Population	Rate per 100 000 Population (95% CI)	No. of Deaths/ Population	Rate per 100 000 Population (95% CI)
Aged ≥80 y[b]										
Overall	391/500 339	78.1 (70.4-85.9)	672/558 298	120.4 (111.3-129.5)	912/615 489	148.2 (138.6-157.8)	1467/686 015	213.8 (202.9-224.8)	2501/748 748	334.0 (320.9-347.1)
Men	125/151 354	82.6 (68.1-97.1)	242/175 881	137.6 (120.3-154.9)	315/201 795	156.1 (138.9-173.3)	497/238 235	208.6 (190.3-227.0)	902/275 627	327.3 (305.9-348.6)
Women	266/348 985	76.2 (67.1-85.4)	430/382 417	112.4 (101.8-123.1)	597/413 694	144.3 (132.7-155.9)	970/447 780	216.6 (203.0-230.3)	1599/473 121	338.0 (321.4-354.5)
Aged 80-84 y										
Overall	113/274 626	41.1 (33.6-48.7)	213/325 193	65.5 (56.7-74.3)	231/341 963	67.6 (58.8-76.3)	359/368 582	97.4 (87.3-107.5)	589/394 936	149.1 (137.1-161.2)
Men	49/93 057	52.7 (37.9-67.4)	103/114 741	89.8 (72.4-107.1)	88/125 720	70.0 (55.4-84.6)	159/144 421	110.1 (93.0-127.2)	270/163 046	165.6 (145.8-185.4)
Women	64/181 569	35.2 (26.6-43.9)	110/210 452	52.3 (42.5-62.0)	143/216 243	66.1 (55.3-77.0)	200/224 161	89.2 (76.9-101.6)	319/231 890	137.6 (122.5-152.7)
Aged 85-89 y										
Overall	144/156 917	91.8 (76.8-106.8)	227/158 439	143.3 (124.6-161.9)	331/190 091	174.1 (155.4-192.9)	534/215 887	247.4 (226.4-268.3)	842/234 300	359.4 (335.1-383.6)
Men	44/43 702	100.7 (70.9-130.4)	78/45 095	173.0 (134.6-211.4)	129/57 780	223.3 (184.7-261.8)	207/69 526	297.7 (257.2-338.3)	342/81 748	418.4 (374.0-462.7)
Women	100/113 215	88.3 (71.0-105.6)	149/113 344	131.5 (110.4-152.6)	202/132 311	152.7 (131.6-173.7)	327/146 361	223.4 (199.2-247.6)	500/152 552	327.8 (299.0-356.5)
Aged 90-94 y										
Overall	96/56 406	170.2 (136.1-204.2)	156/60 967	255.9 (215.7-296.0)	236/67 331	350.5 (305.8-395.2)	383/82 293	465.4 (418.8-512.0)	762/96 978	785.7 (730.0-841.5)
Men	23/12 244	187.8 (111.1-264.6)	44/13 675	321.8 (226.7-416.8)	71/15 560	456.3 (350.2-562.4)	102/20 912	487.8 (393.1-582.4)	227/26 376	860.6 (748.7-972.6)
Women	73/44 162	165.3 (127.4-203.2)	112/47 292	236.8 (193.0-280.7)	165/51 771	318.7 (270.1-367.3)	281/61 381	457.8 (404.3-511.3)	535/70 602	757.8 (693.6-822.0)
Aged ≥95 y										
Overall	38/12 390	306.7 (209.2-404.2)	76/13 699	554.8 (430.1-679.5)	114/16 104	707.9 (577.9-837.8)	191/19 253	992.1 (851.4-1132.7)	308/22 534	1366.8 (1214.2-1519.5)
Men	9/2351	382.8 (132.7-632.9)	17/2370	717.3 (376.3-1058.3)	27/2735	987.2 (614.8-1359.6)	29/3376	859.0 (546.4-1171.7)	63/4457	1413.5 (1064.5-1762.6)
Women	29/10 039	288.9 (183.7-394.0)	59/11 329	520.8 (387.9-653.7)	87/13 369	650.8 (514.0-787.5)	162/15 877	1020.3 (863.2-1177.5)	245/18 077	1355.3 (1185.6-1525.0)

[a] Trend is statistically significant in all groups with a $P < .001$, except for men 95 years or older ($P = .003$).

[b] Crude mortality rate.

Figure. Falls Mortality Rates in Persons 80 Years or Older in the Netherlands, 2000-2016



2. Burns ER, Stevens JA, Lee R. The direct costs of fatal and non-fatal falls among older adults—United States. *J Safety Res*. 2016;58:99-103.

3. Hartholt KA, Polinder S, van Beeck EF, et al. End of the spectacular decrease in fall-related mortality rate: men are catching up. *Am J Public Health*. 2012;102 (suppl 2):S207-S211.

4. Statistics Netherlands. Official Cause-of-Death Statistics Methodology [in Dutch]. https://www.cbs.nl/nl-NL/menu/methoden/dataverzameling/doodsoorzakenstatistiek.htm. Accessed October 29, 2017.

5. Stevens JA, Rudd RA. Circumstances and contributing causes of fall deaths among persons aged 65 and older: United States, 2010. *J Am Geriatr Soc*. 2014; 62(3):470-475.

6. Tinetti ME, Kumar C. The patient who falls: "It's always a trade-off." *JAMA*. 2010; 303(3):258-266.

COMMENT & RESPONSE

Interventions to Prevent Falls in Older Adults

To the Editor Dr Tricco and colleagues[1] compared interventions for preventing falls in older adults. The systematic review and network meta-analysis demonstrated that exercise alone and various combined interventions were associated with lower risk of injurious falls compared with usual care. Some methodological issues deserve comment.

First, exercise is a broadly defined concept because it is a heterogeneous physical activity with respect to type, intensity, and frequency. Exercise was classified as one of the categories of intervention in the network meta-analysis, but it was not clarified what exercise was effective for preventing falls among older adults.

Second, the authors did not state whether final values or changes from baseline were used to determine mean differences for continuous outcomes. We wonder whether they observed no significant baseline differences in continuous outcomes between the treatment groups.

Third, studies reporting continuous outcomes without the associated measure of variance were included in the analysis, with standard errors imputed. Therefore, a subgroup analysis based on the imputed data are needed.

Fourth, the major assumption in network meta-analyses is exchangeability of studies.[2] The validity of network meta-analysis is based on the underlying assumption that there is no imbalance in the distribution of effect modifiers across the different types of direct treatment comparisons.[3] If there is an imbalance in the distribution of effect modifiers between different types of comparisons, indirect comparisons are biased and the validity of the network meta-analysis is compromised.[3] Our concern is that it is difficult to guarantee that the common comparators are transitive, which means that the placebo groups are adequately similar across clinical trials. Even though the baseline characteristics were similar across trials, the possibility of uneven distribution of unknown effect modifiers cannot be ruled out.

Although the authors showed no evidence of significant inconsistency across the network meta-analysis, it is not enough to assess the appropriateness of the assumptions from clinical and methodological viewpoints.[2] The findings depend on clinical and epidemiological judgment in context and need to be verified conceptually and epidemiologically.

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1. Tricco AC, Thomas SM, Veroniki AA, et al. Comparisons of interventions for preventing falls in older adults: a systematic review and meta-analysis. *JAMA*. 2017;318(17):1687-1699.

2. Dias S, Sutton AJ, Ades AE, Welton NJ. Evidence synthesis for decision making 2: a generalized linear modeling framework for pairwise and network meta-analysis of randomized controlled trials. *Med Decis Making*. 2013;33(5): 607-617.

3. Jansen JP, Naci H. Is network meta-analysis as valid as standard pairwise meta-analysis? it all depends on the distribution of effect modifiers. *BMC Med*. 2013;11(1):159.

In Reply Drs Lee and Song make an important point about exercise being a broad category, which in our review could have ranged from tai chi to strength training. Given the number and complexity of interventions included in our review, it was not possible to analyze the types of exercise further, as there were too many nodes for network meta-analysis to be feasible. Therefore, all studies involving any form of exercise were combined. To further clarify what types and components of exercise are most effective, we are currently conducting a separate network meta-analysis of the exercise studies from our original review, using a coding scheme of approximately 25 different exercise codes that will allow us to break down each exercise into its components.

For our single continuous outcome (quality of life), we used the final values to determine the mean differences. The change from baseline was not used due to lack of data on the variability of change from baseline and insufficient data to impute this variability. Because of the paucity of studies, we were unable to further explore the baseline differences.

Based on the quality-of-life data, only 1 pairwise meta-analysis was feasible comparing exercise vs usual care using