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Is living alone associated with mortality among older primary care patients with or without diabetes?

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Abstract

Aims The aim of this study was to evaluate the association between living alone and mortality among older patients with and without diabetes.

Methods Electronic patient records were used to identify patients at least 65 years of age with a diagnosis of diabetes and two age- and sex-matched controls without diabetes for each patient with diabetes in 2015. The study population in this analysis consisted of 429 patients with diabetes and 650 controls who returned a questionnaire that contained questions about their diseases, symptoms, and functions. The mortality (2015–2019) data were based on the national registry of Statistics Finland. Cumulative mortality was estimated with Kaplan–Meier's method and compared with the log-rank test. Cox proportional hazards regression was used to estimate the adjusted hazard ratios (HR) and their 95% confidence intervals (CI).

Results The median follow-up time was 4.3 years. 208 of the controls (32%) and 156 (36%) of the patients with diabetes lived alone. Of the controls, 8.1% (95% CI 5.9–11.1) of those not living alone and 20.2% (95% CI 15.3–26.3) living alone died. The corresponding numbers for patients with diabetes were 15.1% (95% CI 11.3–19.8) and 28.8% (95% CI 22.4–36.7). Among all patients, living alone was associated with increased mortality (HR = 1.84; 95% CI 1.30–2.61), whereas the diagnosis of diabetes was not (HR = 1.31; 95% CI 0.94–1.81).

Conclusions The results of this study show that living alone had a significant impact on the mortality of older patients, regardless of whether they had diabetes or not. Diabetes was not clearly associated with the increased mortality among these older home-dwelling patients.

Keywords Diabetes, Mortality, Living alone, Primary care

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Background

The population is aging worldwide and at the same time the prevalence of type 2 diabetes is rising. There has also been a change in how people live: increasingly, more people, especially older adults, are living in single-person households [1]. About one-fifth of the population in Finland lives alone [2], whereas single-person households constitute about one-third of all the households in the European Union [3].

Living alone and loneliness play an important role in people's mental and physical health. Living alone increases the risk for developing diabetes [4] though in some studies the risk was higher only among men [5]. In addition, patients with chronic diseases who live alone are less likely to adhere to self-care, potentially resulting in less optimal disease management outcomes [6].

In addition to loneliness [7], several studies have shown an association between living alone and mortality [8–11]. A previous population-based study has found that living alone is associated with an increased mortality rate in older men even after controlling for loneliness [12]. However, only a few studies [13] have focused on the relationship between living alone and mortality among patients with diabetes. The number of studies on this relationship is especially low among the older, primary care-based population with diabetes.

The number of older patients with diabetes is increasing. Primary care has a major role in diabetes management. In addition to adequate medical treatment, we need more knowledge on factors that potentially have an influence on outcomes. Living alone is common among older people and may result in worse self-care and management of diabetes. Thus, it can be hypothesized that living alone may be associated with increased mortality especially in patients with diabetes. Therefore, the aim of this study was to evaluate the association between living alone and mortality among older home-dwelling people with and without diabetes in a primary-care setting.

Methods

Study population

This study is part of the Inner-Savo DM65+study and a more detailed description of the methodology has been given previously [14]. The data were from the Inner-Savo district with a total population of 10,793. The present study was designed to collect data from a rural community (communities of Suonenjoki and Rautalampi) to support service planning. Home-dwelling individuals aged at least 65 years formed the basic population (N=3,093) in this study. Based on the International Classifications of Diseases (ICD-10) [15] patients with diabetes (E10 and E11) and two sex- and age matched controls without diabetes were extracted from the primary care electronic patient records. A questionnaire was sent by mail in the year 2015 to 890 patients without diabetes and to 527 patients with diabetes. A total of 650 controls and 429 patients with diabetes answered and returned the health questionnaire. The survey was conducted following the ethical principles set by the National Advisory Board on Research Ethics of Finland https://tenk.fi/sites/tenk.fi/files/ethicalprinciples.pdf. The study protocol was reviewed and approved by the Research Ethics Committee of the Northern Savo Hospital District, Kuopio, Finland (256/2015) and approved by the Inner Savo Health Care Federation of Municipalities (61 A/2015). By filling out and returning the survey, all participants gave their informed consent.

Measurements

The questionnaire included several previously developed measures. The Geriatric Depression Scale (GDS-15) [16] was used to evaluate depressive symptoms. Physical activity was measured with the Kasari-FIT index [17], which includes questions on the frequency, intensity, and duration of exercise. Alcohol consumption was screened with the Alcohol Use Disorders Identification Test C (AUDIT-C) [18], in which a high score indicates harmful alcohol use. Living alone was evaluated with the question "How do you live?", with answer options "Alone", "With spouse", "With child", "With someone else, who?". Loneliness was evaluated with the question "Do you feel lonely?", with answer options "Never", "Very rarely", "Sometimes", "Quite often", "Constantly". The mortality (2015–2019) data were based on the national registry of Statistics Finland.

Statistical analysis

Demographic factors and clinical symptoms were described by means and standard deviations (SD) or frequencies and percentages. Statistical comparisons between diabetes and living groups were performed using generalized linear models with the appropriate distribution and link function. Statistical interferences were evaluated by using two-way factorial models. Models included the main effects (diabetes and living) and the interaction effects between them. Kaplan-Meier curves were adjusted using inverse probability weighting (IPW). We used the Cox proportional hazards model to calculate the adjusted hazard ratios (HR) with 95 per cent confidence intervals (95% CI). The proportionality assumption was evaluated by plotting the log–log of survival probability against log (time). The statistical models were adjusted for age, sex, smoking, alcohol use, number of chronic diseases, education years, perceived loneliness and being able to move without aid. The ratio between observed and expected numbers, Standardized Mortality Ratio (SMR), was calculated using subject-years methods with 95% confidence intervals (CI), assuming a Poisson

distribution. The expected number of deaths was calculated based on sex-, age- and calendar-period-specific mortality rates in the total Finnish population (Official Statistics of Finland). The expected number was determined by multiplying the person-years of observation by the appropriate mortality rate in the general population categorized by sex, 1-year age group and calendar period. Stata 17.0 (StataCorp LP, College Station, TX, USA) were used for the analysis.

Results

The study population consisted of 650 patients without diabetes and 429 patients with diabetes (of whom 12 had type 1 diabetes). The median follow-up time was 4.3 years. Table 1 shows the main characters of the study group. Patients with diabetes were older, had less educational years, felt lonelier and had more comorbidities than the controls. Patients without diabetes were more likely able to move without aid, had higher physical activity, were more likely to smoke and had fewer depressive symptoms than patients with diabetes.

32% of the patients without diabetes and 36% of the patients with diabetes lived alone. Patients living alone were more likely women, were older, had lower education years, were more likely to feel lonely and had more comorbidities than patients not living alone. Patients not living alone were more likely able to move without aid, had higher physical activity, used more alcohol and had fewer depressive symptoms than those living alone. (Table 1)

Of the patients with diabetes, 28.8% (95% Cl 22.4–36.7) of those living alone and 15% (95% Cl 11.3–19.8) not living alone died. Respectively, 20.2% (95% Cl 15.3–26.3) of the controls without diabetes who lived alone and 8.1% (95% Cl: 5.9–11.1) who did not live alone died.

To assess the mortality rate in relation to the total population of Finland of the same age, a comparison between our study patients and the general population was made using standardized mortality rates (SMR). Compared with the total population, there were no significant differences in mortality among patients without (SMR 0.81, 95% CI 0.65–1.01) and with diabetes (SMR1.17; 95% 0.95–1.45). In general, compared with the total population, mortality was higher among patients who lived alone. (Table 2) Patients with diabetes who lived alone experienced higher mortality rates but patients without diabetes who lived alone did not have significantly higher mortality rates compared with the total population.

Table 1 Characteristics of the study subjects without and with diabetes who did not live alone and lived alone

	No diabetes		Diabetes		*P*-value		
	Living alone		Living alone		Diabetes	Living	Interaction
	No *N* = 442	Yes *N* = 208	No *N* = 273	Yes *N* = 156			
Age, years, mean (SD)	73 (6)	76 (7)	74 (6)	78 (8)	0.016	< 0.001	0.12
Women, n (%)	211 (48)	145 (70)	113 (41)	105 (67)	0.18	< 0.001	0.60
Education years, mean (SD)	10.1 (3.3)	9.4 (3.0)	9.6 (3.1)	8.8 (2.7)	0.005	< 0.001	0.79
Feeling lonely, n (%)					0.029	< 0.001	0.11
Never	364 (82)	110 (53)	201 (74)	79 (51)			
Sometimes	69 (16)	67 (32)	59 (22)	53 (34)			
Quit often/constantly	9 (2)	31 (15)	13 (5)	24 (15)			
Physical activity, Kasari-FIT Index, mean (SD)	42 (23)	35 21)	31 (22)	26 (20)	< 0.001	< 0.001	0.75
Able to move without aid, n (%)	398 (90)	146 (70)	206 (75)	92 (59)	< 0.001	< 0.001	0.057
Alcohol use, AUDIT-C, mean (SD)	2.1 (2.1)	1.9 (2.2)	2.1 (2.2)	1.4 (2.0)	0.076	0.002	0.076
Smoking, n (%)	41 (9)	26 (13)	15 (5)	8 (5)	0.003	0.62	0.44
Depressive symptoms, GDS-15, mean (SD)	2.4 (2.8)	3.0 (3.1)	3.1 (3.1)	4.0 (3.0)	< 0.001	< 0.001	0.44
Comorbidities, n (%)							
High blood pressure	218 (50)	114 (56)	190 (71)	113 (75)	< 0.001	0.13	0.90
Cardiovascular disease	64 (15)	31 (15)	49 (18)	43 (28)	0.002	0.067	0.11
Cancer	25 (6)	17 (8)	16 (6)	9 (6)	0.56	0.46	0.45
Rheumatoid arthritis	21 (5)	10 (5)	10 (4)	7 (5)	0.61	0.70	0.74
Osteoarthritis	110 (25)	56 (27)	75 (28)	54 (36)	0.069	0.10	0.40
Chronic spine disease	100 (23)	55 (27)	66 (25)	39 (26)	0.91	0.36	0.62
Asthma/COPD	45 (10)	22 (11)	34 (13)	26 (17)	0.049	0.30	0.43
Hypothyroidism	62 (14)	31 (15)	46 (17)	32 (21)	0.073	0.33	0.60
Mental illness	13 (3)	11 (5)	9 (3)	13 (9)	0.031	0.008	0.53
Number of comorbidities, mean (SD)	1.5 (1.3)	1.7 (1.4)	1.8 (1.3)	2.2 (1.4)	< 0.001	0.001	0.28

*Excluding diabetes

SD = Standard deviation; AUDIT-C = Alcohol Use Disorders Identification Test; GDS-15 = Geriatric Depression Scale; COPD = chronic obstructive pulmonary disease

Table 2 Mortality of patients not living alone and living alone compared with the total population of Finland expressed by standardized mortality ratio (SMR)

	Not living alone	Living alone
	SMR (95% CI)	SMR (95% CI)
All	0.76 (0.61 to 0.95)	1.28 (1.04 to 1.58)
Diabetes		
Yes	0.58 (0.42 to 0.81)	1.36 (1.01 to 1.82)
No	0.59 (0.42 to 0.82)	1.21 (0.89 to 1.63)

SMR = Standardized Mortality Ratio, CI = Confidence interval

Compared with the total population, mortality was lower among patients with and without diabetes who did not live alone.

In the study population, hazard ratios (HR) indicated that among study patients, diabetes was not associated with mortality (HR 1.31, 95% CI: 0.94–1.81, $p=0.11$) but living alone had a significant impact on mortality (HR 1.84, 95% Cl: 1.30–2.61, $p<0.001$). Figure 1 shows the mortality rate during the follow-up time separately for patients who did not live alone and who lived alone. There was no significant difference in the 4-year mortality rate between patients without and with diabetes in either of these two groups.

Table 3 shows the mortality rate among study patients expressed with HR. Compared with the study patients who did not have diabetes and did not live alone, the mortality risk was highest among patients with and without diabetes who lived alone. When it comes to gender, the mortality was higher among men (reference group: women without diabetes and not living alone) and the

Table 3 Adjusted mortality (adjusted for age, sex, smoking, alcohol use, number of chronic diseases, education years, perceived loneliness and being able to move without aid) in subjects not living alone and living alone and in subjects without diabetes (controls) and with diabetes expressed with hazard ratio with 95% confidence intervals (CI)

	Not living alone	Living alone
	Hazard ratio (95% CI)	Hazard ratio (95% CI)
All		
No diagnosis of diabetes	1.00 (Reference)	1.91 (1.19 to 3.05)
Diagnosis of diabetes	1.40 (0.88 to 2.23)	2.17 (1.34 to 3.49)
Women and men[1]		
Women without diabetes	1.00 (Reference)	1.83 (0.90 to 3.71)
Women with diabetes	1.91 (0.87 to 4.21)	2.31 (1.16 to 4.61)
Men without diabetes	2.71 (1.32 to 5.55)	5.84 (2.71 to 12.61)
Men with diabetes	3.29 (1.64 to 6.58)	5.46 (2.45 to 12.15)

[1] Women not living alone and not having diabetes were the reference group

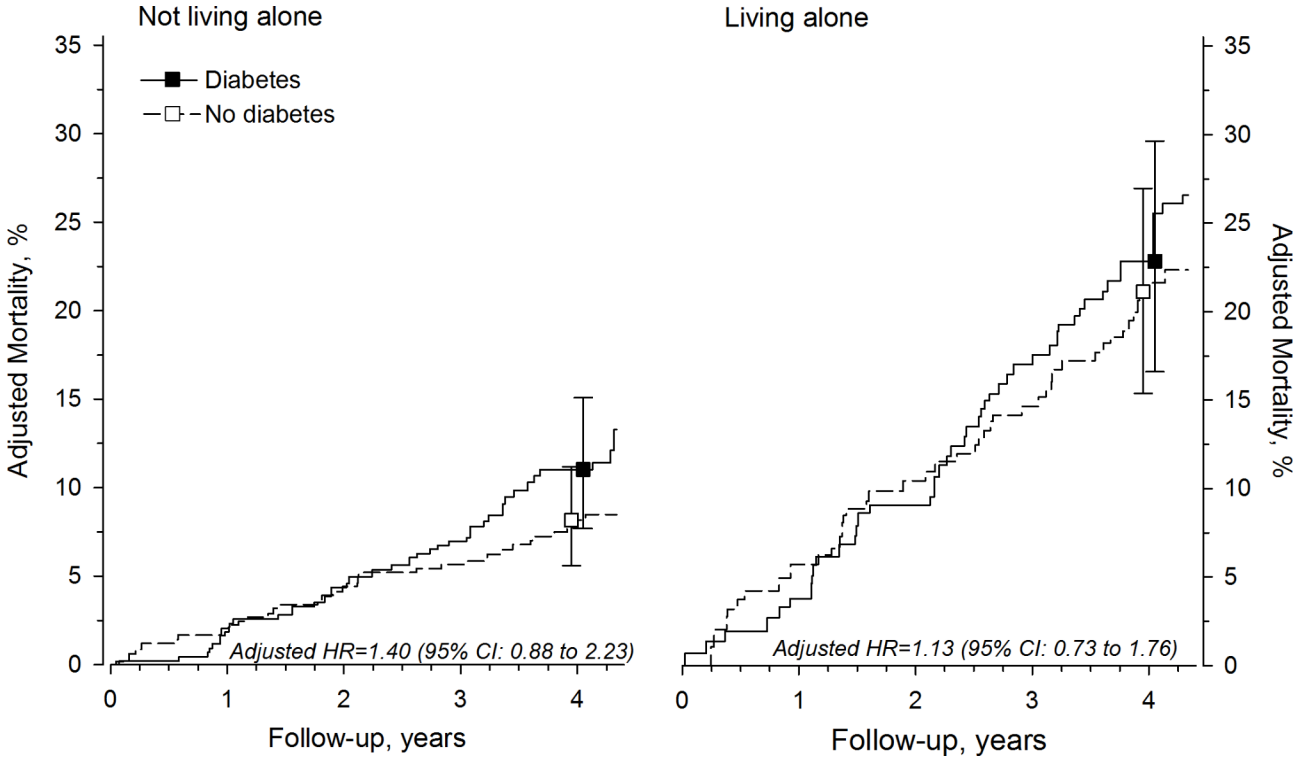

Fig. 1 Adjusted mortality during the follow-up time (adjusted for sex, age, education years, smoking, alcohol use, perceived loneliness, number of chronic diseases, and being able to move without aid). The whiskers show the 95% confidence interval for four-year mortality. HR = Hazard Ratio, CI = Confidence Interval

highest mortality was seen among men living alone with and without diabetes.

Discussion

This study evaluated the association between living alone and mortality among older, home-dwelling primary care patients with diabetes and their age and sex matched control patients without diabetes. The results of this study showed that living alone had an impact on the mortality of older patients with and without diabetes especially among men. Compared with the total population, mortality was higher in the patients who had diabetes and lived alone. However, in our study population diabetes did not have strong influence on mortality. Thus, the strongest associations with mortality were found for living alone and male gender.

Our study focused on older primary care patients, who exhibited increased mortality rates among both men and women. In general, the results of this study are in line with previous studies, which show an association between increased mortality and living alone [8–11]. This association is also seen among middle-aged patients who have type 2 diabetes [13]. However, not all previous studies have shown this connection [19], or it was only observed among men [20]. Accordingly, in our study hazard of mortality was the highest among men. Some of the previous studies found an association between living alone and mortality only among younger age groups. In an Australian study, living alone increased mortality among people under 75 years old, but not among those older than 75 [21].

In the present study, we were able to assess the significance of living alone separately for older primary care patients having a common chronic disease and in those older patients not having this disease (diabetes). In our study, older home-dwelling people with diabetes did not have a higher risk of mortality than people without the diagnosis of diabetes. This result may be explained by many factors. Home-dwelling people with diabetes are usually in better physical and mental health than those living in institutional care. Living alone seemed to affect study subjects with and without diabetes in a similar manner; however, for subjects with diabetes the standardized mortality rate seemed to be slightly higher in comparison with the general population. Among the study subjects, according to our previous study [22], people with diabetes visited general practitioners and nurses more often. In Finland, the follow-up and treatment of patients with diabetes are guided by the national Current Care Guidelines [23]. Thus, the guideline-based well-organized follow-up of patients with diabetes might serve as a protective factor, especially among older people. It is also possible that the continuity of care is better among those with a diagnosis of diabetes than among those without. Continuity of care has been associated with lower mortality [24].

The underlying mechanism behind the association between living alone and mortality is likely multifactorial. Studies have shown that older people living alone have more doctor's appointments and emergency visits than those living with someone [25]. In general, this may indicate worse overall health or less optimal health behaviors among patients living alone. People living alone more commonly experience depressive symptoms or anxiety compared to people living with someone [26], and they have a higher risk of suicide [27]. Similarly, in the present study, older people who lived alone had more depressive symptoms.

Having type 2 diabetes imposes a significant burden on one's health. Previous studies have shown that patients with type 2 diabetes have a higher mortality rate compared with those without diabetes [28, 29] and the same connection is seen among older patients [30]. However, mortality seems to be lower if diabetes is diagnosed at an older age compared with patients who are diagnosed with diabetes at a younger age [31].

The strengths of this study include a study population that comprehensively represented older, home-dwelling people under primary care with and without diabetes, and a considerably high participation rate. Mortality rates were based on a national registry. However, the study population consisted of older people living in rural communities, which must be considered when generalizing the results. Although the patients' characteristics were like those in our previous Finnish primary care setting study [32], there may be differences in how the management of chronic diseases and primary care are organized in more urban municipalities or cities. We were not able to assess continuity of care.

Conclusions

The results of this study show that living alone has an association with increased mortality among older, home-dwelling patients, especially in men. Therefore, it should be regarded as an important risk factor among older primary care individuals with and without diabetes. Diabetes was not clearly associated with increased mortality, which may be related to the well-organized follow-up system for home-dwelling patients with diabetes in Finland. However, further studies are needed to evaluate the role of care continuity and any interventions that may potentially influence the excess mortality risk among older people living alone.

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Author contributions
A. A., P. M. and H. K. contributed to the statistical analyses. A. A. wrote the first draft of the article. J. S. M. K., M. T., M. H. and P. M. contributed to the interpretation of the data and drafting and critical revision of the manuscript. A. A., H. K. and P. M. contributed to the design of the study. M. K., M. T., H. K. and P. M. contributed to the acquisition of data. A. A. and P. M are the guarantors of this work and, as such, had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

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Data availability
No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate
The survey was conducted in accordance with the ethical principles set by the National Advisory Board on Research Ethics of Finland (15). The study protocol was reviewed and approved by the Research Ethics Committee of the Northern Savo Hospital District, Kuopio, Finland (256/2015) and approved by the Inner Savo Health Care Federation of Municipalities (61 A/2015). By filling out and returning the survey, all participants gave their informed consent.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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