



## Time trends in loneliness from 1984 to 2019 among 27,032 older adults in Norway: A HUNT study

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### ABSTRACT

The aging population and increasing evidence of the detrimental health impacts of loneliness emphasize the importance of studying and predicting changes in loneliness prevalence among older adults. To understand and project changes in loneliness over time, we examined 35-year trends in adults aged 70 and older, considering factors such as sex, age, and living situation. Cross-sectional data from 27,032 home-dwelling adults aged 70 years and older who participated in at least one of the four Norwegian HUNT surveys from 1984 to 2019, and Norwegian population data from Statistics Norway were used for the analyses. Loneliness was self-reported, and the prevalence of loneliness was standardized to the Norwegian population at the survey year by age and sex. The results showed that the prevalence of loneliness significantly decreased between each survey. The higher categories of loneliness (a good amount, very much) decreased, from 11.4% (1995–97), 6.7% (2006–08), and 5.8% (2017–19). Across surveys, loneliness was significantly more common among women, the oldest, and those living alone. The prevalence of loneliness among the oldest adults living alone increased from 2006 to 2019. The gradual decline in loneliness observed from 1995 to 2019 coincided with notable societal changes in Norway. We estimated that the number of older adults experiencing loneliness in Norway could rise from 184,000 in 2020 to 286,000 in 2035, and potentially reach 380,000 in 2050.

### 1. Introduction

Recent changes towards more individualistic societies have raised global concerns about increasing social isolation and loneliness (Chawla et al., 2021; Dykstra, 2009; Surkalim et al., 2022; WHO, 2021). These concerns are framed and heightened by growing evidence that loneliness has negative consequences for physical, cognitive and mental health, and independence in later life (Hawkey and Cacioppo, 2010; Solmi et al., 2020), with major implications for welfare states already confronting challenges posed by population aging. The National Academies of Sciences (US) have emphasized the importance of healthcare systems addressing social isolation and loneliness, recognizing the need

for preventative interventions that extend beyond traditional healthcare services (National Academies of Sciences Engineering and Medicine, 2020).

In Western countries, the prevalence of loneliness during adulthood tends to be stable into older ages but to increase after age 75 (Dykstra, 2009; Hansen and Slagsvold, 2016; Hawkey et al., 2019; Luhmann and Hawkey, 2016; Mund et al., 2020; von Soest et al., 2018). The risk of loneliness in later life is associated with losses in the domains of health, social roles, close relationships and, above all, the loss of a spouse or partner (Bergland and Engedal, 2011; Dahlberg et al., 2022; Hansen and Slagsvold, 2016; Hawkey et al., 2022; Nicolaisen and Thorsen, 2014; Tomstad et al., 2017; von Soest et al., 2018). It is predicted that the

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number of older adults living alone and preferring to age in place (Wiles et al., 2012) will increase due to large birth cohorts, increased life expectancy and government policies promoting aging at home (Norwegian Ministry of Health, 2017).

While surveillance of time trends in loneliness has major academic and public relevance, there is sparse evidence available, particularly from multiple surveys over a long time period using repeated and comparable measures (Surkalim et al., 2022). Cross-sectional studies indicate that the risk of late-life loneliness in European countries is the lowest in the Nordic countries and the highest in south-eastern countries (Chawla et al., 2021; Hansen and Slagsvold, 2016). These findings highlight notable differences in the prevalence of loneliness between different countries and regions. Despite the Nordic countries being considered more individualistic, the prevalence of loneliness is lower in these countries, which can be attributed to their stronger welfare-oriented policies and social protections. Factors such as values, norms, family and social life, economy, technology and living conditions at the macro-level influence loneliness (Luhmann et al., 2023). The relatively better social protections, economy, health, and living conditions available for older people in stronger welfare states may predict distinct and gendered time trends in loneliness in the Nordic countries (Hansen and Slagsvold, 2016; Hansen and Slagsvold, 2017).

Only a few studies have investigated time trends in the prevalence of loneliness among adults aged 70 years or older. A Swedish longitudinal study of people aged 77+ years reported stable levels of loneliness during 1992–2014 (Dahlberg et al., 2018). Similarly, another Swedish study found high but stable levels of loneliness among those aged 85+ during three surveys during 2002–2012 (Nygqvist et al., 2017). A study of Finns aged 70 years reported similar levels of loneliness in 1991 and 2011 (Eloranta et al., 2015). Studies from other Western countries have indicated either stable or decreasing levels of loneliness among older adults (Hawkey et al., 2019; Hülür et al., 2016; Suanet and van Tilburg, 2019; Surkalim et al., 2023; Tesch-Romer et al., 2013; Vlaming et al., 2014). Based on data from >18,000 participants, a recent study from the US found that loneliness among older Americans have decreased (Surkalim et al., 2023). Most studies on loneliness prevalence are from Western countries (Surkalim et al., 2022). However, a study from China have found an increase in loneliness among older adults (Yan et al., 2014)

Overall, the evidence regarding time trends in loneliness among older adults is limited and shows variability across countries and regions. Furthermore, there is a lack of recent data, which is unfortunate considering the large demographic changes due to population aging. In this study, we investigate the overall time trends in the prevalence of loneliness during 1984–2019 among a large number home-dwelling adults aged 70+ years in a specific region of Norway. We examine these trends by sex, age and living situation. Additionally, we project the number of older adults expected to experience loneliness to year 2050.

## 2. Methods

### 2.1. Study design and participants

We performed a cross-sectional study using Norwegian regional data during 1984–2019. Our study population comprised home dwellers aged 70+ years in each of the four Trøndelag Health Studies HUNT1 (1984–86), HUNT2 (1995–97), HUNT3 (2006–08) and HUNT4 (2017–19). The former Nord-Trøndelag County is situated in the middle of Norway and is characterised by a stable and homogeneous population. In HUNT1–4, all county residents aged 20+ years were invited (Åsvold et al., 2021), while our study were limited to participants aged 70+ years. The number invited and response rates among the 70+ population were: In HUNT1, 12,361 (88%), in HUNT2, 10,771 (66%), in HUNT3, 8184 (55%), in HUNT4, 11,898 (62%) (<https://www.ntnu.edu/hunt/participation>). In HUNT1 and HUNT4, nursing home residents were included, but not in HUNT2 and HUNT3. For fair comparison

across study waves, nursing home residents were excluded (HUNT1:  $n = 944$ ; HUNT4:  $n = 512$ ), leaving 11,417 HUNT1 participants for assessment (81%) and 11,386 HUNT4 participants (59%). Assessments with missing data for loneliness ( $n = 7810$ , 18%) or living situation ( $n = 4695$ , 11%) were excluded from the analyses, leaving 27,032 individuals and 32,544 assessments for complete case analysis. The higher number of assessments is because some participated in two or three surveys. Most of these respondents (81%) participated in only one survey, some participated in two (19%) or three (1%) and none participated in all four. Even if some participated in multiple surveys, each survey was treated as an independent sample of those aged 70 years and older.

### 2.2. Loneliness

Loneliness and living situation were self-reported, while age and sex were registry based. In all the HUNT surveys, loneliness was assessed using a single question, which generally demonstrates less reliability and validity than multi-item scales avoiding the term 'lonely' (Hansen and Slagsvold, 2016). However, single items have been shown to have adequate psychometric properties (Mund et al., 2023). The HUNT1 item 'Do you often feel lonely?' used a five-point response scale including 'very often', 'often', 'sometimes', 'very rarely', and 'never'. In HUNT2–4, loneliness was assessed by the item, 'In the last 2 weeks, have you felt lonely?', with four possible responses: 'no', 'a little', 'a good amount', and 'very much'. For the main analysis, we dichotomised loneliness into 'Not lonely' and 'Lonely' for each wave. For HUNT1, 'Not lonely' included the responses 'never' and 'very rarely'; the other responses were classified as 'Lonely'. For HUNT2–4, 'no' was classified as 'Not lonely', and the other responses were coded as 'Lonely'. The reason to use such low threshold was to capture and include all severity levels of loneliness, with the recognition that also mild levels can increase the risk of mental and physical health outcomes. However, Table 2 (notes) shown time-related prevalence for each response category, and estimated projected numbers for also mild levels of loneliness ('somewhat lonely') is presented in Fig. 4.

### 2.3. Other study variables

In all surveys, participants were asked whether they lived alone, with a partner, or with children; in HUNT1, they were also asked whether they lived with parents or parents-in-law. Living situation was dichotomized into 'Living alone' (for the response 'lived alone') or 'Living with someone' (for all other responses). Age was grouped as 70–74, 75–79, 80–84, and 85 years and older and was also dichotomized using 80 years as a cut-off.

### 2.4. Statistical analysis

Stata 17 was used for the analyses. Three sets of numbers were estimated. First, crude prevalence of loneliness by age, sex, and living situation was estimated. Second, age- and sex-standardized prevalence of loneliness was estimated using four Norwegian standard populations, one for each HUNT survey by age (70–74, 75–79, 80–84, 85+) and sex. For HUNT1, the full Norwegian 1986 population was used, while for HUNT2–4, the 1996, 2007, and 2019 populations were used, respectively. We standardized to the Norwegian population to get national estimates and to correct for higher drop out in the higher age groups. Third, we estimated national projections of the number of older adults having any feeling of loneliness the coming decades, in addition to the numbers not feeling lonely, feeling somewhat lonely (response category 'a little') and feeling very lonely ('a good amount' or 'very much'). These estimations were done by fixating the standardized prevalence of reported loneliness in HUNT4 by age and sex and then multiplying these prevalence data with population data from Statistics Norway by the same age groups and sex for the years 2020, 2025, 2035, and 2050. For testing of differences between groups, weighted binominal regression

analysis with an identity link was applied. This method was also used to investigate drivers for the time trends in loneliness.

2.5. Sensitivity analyses

Two sets of sensitivity analyses were performed. First, nursing home residents in HUNT1 and HUNT4 were included. Second, in HUNT4, respondents were allowed to have their interviews and testing performed at their homes if they had difficulties meeting at the examination station. For comparative purposes, these participants' responses were excluded in the main analyses. However, in a sensitivity analysis, these home-based interviews from HUNT4 were included. This was done to investigate whether loneliness differed much due to differences in sampling. Finally, analyses were performed to take into account that some respondents participated in more than one of the surveys with repeated measurements of loneliness (we applied the vce cluster command in Stata). However, loneliness prevalence results were identical to three decimal places, so we did not use this correction in the main analyses as the weighting procedure did not accommodate for the vce cluster approach.

2.6. Role of the funding source

The funders had no role in the study design, data collection, data analysis, data interpretation, or writing of the report.

2.7. Disclosure of ethical compliance and approval

The study met the guidelines for protection of human data concerning safety and privacy at Norwegian Institute of Public Health, Oslo, Norway. The study is part of the project "Funksjonsfriske leveår blant eldre i Norge" (Years at healthy functioning among older adults in Norway), which was assessed by the Norwegian Regional Ethics Committee for medical research (REC) reference number 2019/149. Participants in the HUNT surveys gave written informed consent.

3. Results

For women, the mean (SD) age increased from 76.7 (5.4) years in HUNT1 to 77.6 (6.1) years in HUNT4; for men during the same period, the mean age increased from 76.3 (5.1) years to 77.0 (5.6) years (Table 1). Single households were more than twice as common among

women than among men in all surveys; in HUNT1, 44.6% of the women lived alone while only 19.8% of the men lived alone. The corresponding numbers in HUNT4 were 45.4% and 20.8%.

Crude prevalence of loneliness declined from 42.4% in HUNT1 to 33.0% in HUNT2, to 26.9% in HUNT3, and 26.1% in HUNT4 (Table 2). Among women, crude prevalence of loneliness was 52.3% in HUNT1, 41.5% in HUNT2, 33.5% in HUNT3, and 31.0% in HUNT4. The corresponding prevalence among men were 30.5%, 22.8%, 19.2%, and 20.8%. Loneliness increased gradually by age (Table 2).

Figs. 1, 2, and 3 illustrate time trends in standardized prevalence of loneliness (low threshold), using the Norwegian population, at the last year of each of the four HUNT surveys, as standard population. As shown in Fig. 1, both overall and for women, loneliness declined between all study waves ( $p < 0.01$ ), while for men, loneliness declined until HUNT3 and then levelled out in HUNT4. From HUNT1 to HUNT4, the overall standardized prevalence declined, lowering from 44.7% in HUNT1 (95% confidence interval [CI] 43.6–45.7) to 35.4% in HUNT2 (95% CI 34.4–36.5), then to 30.0% in HUNT3 (95% CI 28.9–31.1), and 27.8% in HUNT4 (95% CI 26.9–28.6). In all surveys, standardized prevalence of loneliness was substantially higher among women than men.

As shown in Fig. 2, considerably higher levels of loneliness were reported among those living alone compared to those living with someone. Among men in single households in HUNT1, 65.3% reported being lonely, while only 22.4% of non-single men reported being lonely. In HUNT4, the corresponding prevalence was 60.3% and 10.8%. Similarly, among women in HUNT1, 67.8% in single households reported being lonely, compared to 40.3% in non-single households. In HUNT4, the corresponding prevalence was 51.4% and 15.2%. There were no significant differences between HUNT3 and HUNT4 within these subgroups.

As shown in Fig. 3, higher age was associated with a higher prevalence of loneliness in all HUNT surveys. In HUNT1, the standardized prevalence of loneliness was 11.2 percentage points higher among those 80 years and older than among those 70–79 years old; in HUNT4, the difference between the same age groups was 21.2 percentage points. Loneliness declined over time for both age groups from HUNT1–3, but from HUNT3 to HUNT4, it declined only in the youngest age group. In single households, there was no difference in loneliness between these age groups in HUNT1 and HUNT2, but in HUNT3 and HUNT4, the prevalence was higher for those 80 years and older. In non-single households in all HUNT surveys, the prevalence of loneliness was significantly higher for those 80 years and older compared to those

**Table 1**  
Descriptive statistics for HUNT1–4, including mean, number, standard deviation (SD) and frequencies; n (%).

|                         | HUNT1<br>1984–86<br>N 11,448 |        | HUNT2<br>1995–97<br>10,939 |        | HUNT3<br>2006–08<br>N 8412 |        | HUNT4<br>2017–19<br>N 12,092 |        |
|-------------------------|------------------------------|--------|----------------------------|--------|----------------------------|--------|------------------------------|--------|
| <b>Women N = 23,278</b> |                              |        |                            |        |                            |        |                              |        |
| Age, mean (SD)          | 76.7                         | (5.4)  | 77.1                       | (5.1)  | 77.5                       | (5.4)  | 77.6                         | (6.1)  |
| Age, years              | n                            | (%)    | n                          | (%)    | n                          | (%)    | n                            | (%)    |
| 70–74                   | 2681                         | (42.3) | 2250                       | (36.9) | 1622                       | (34.9) | 2413                         | (38.9) |
| 75–79                   | 1950                         | (30.8) | 2042                       | (33.5) | 1455                       | (31.3) | 1762                         | (28.4) |
| 80–84                   | 1110                         | (17.5) | 1221                       | (20.0) | 1014                       | (21.8) | 1081                         | (17.4) |
| 85+                     | 593                          | (9.4)  | 588                        | (9.6)  | 553                        | (11.9) | 943                          | (15.2) |
| Lives alone             |                              |        |                            |        |                            |        |                              |        |
| No                      | 2810                         | (55.4) | 2579                       | (49.4) | 2098                       | (51.6) | 3355                         | (54.6) |
| Yes                     | 2266                         | (44.6) | 2640                       | (50.6) | 1970                       | (48.4) | 2787                         | (45.4) |
| <b>Men, N = 19,101</b>  |                              |        |                            |        |                            |        |                              |        |
| Age, mean (SD)          | 76.3                         | (5.1)  | 76.5                       | (5.0)  | 76.9                       | (5.1)  | 77.0                         | (5.6)  |
| Age, years              | n                            | (%)    | n                          | (%)    | n                          | (%)    | n                            | (%)    |
| 70–74                   | 2333                         | (45.6) | 2032                       | (42.0) | 1499                       | (39.8) | 2275                         | (42.3) |
| 75–79                   | 1544                         | (30.2) | 1609                       | (33.3) | 1163                       | (30.9) | 1590                         | (29.5) |
| 80–84                   | 836                          | (16.3) | 802                        | (16.6) | 784                        | (20.8) | 901                          | (16.7) |
| 85+                     | 401                          | (7.8)  | 395                        | (8.2)  | 322                        | (8.5)  | 615                          | (11.4) |
| Lives alone             |                              |        |                            |        |                            |        |                              |        |
| No                      | 3485                         | (80.2) | 3304                       | (78.3) | 2662                       | (81.3) | 4226                         | (79.2) |
| Yes                     | 858                          | (19.8) | 918                        | (21.7) | 614                        | (18.7) | 1112                         | (20.8) |

**Table 2**  
Crude prevalence of loneliness by survey, sex, age groups and living situation for men and women separately.

|              | HUNT1 (1984–86) |             | HUNT2 (1995–97) |             | HUNT3 (2006–08) |             | HUNT4 (2017–19) |             |
|--------------|-----------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|-------------|
|              | Feeling lonely* |             | Feeling lonely* |             | Feeling lonely* |             | Feeling lonely* |             |
|              | No              | Yes         | No              | Yes         | No              | Yes         | No              | Yes         |
|              | n (%)           | n (%)       | n (%)           | n (%)       | n (%)           | n (%)       | n (%)           | n (%)       |
| <b>Total</b> | 5127 (57.6)     | 3774 (42.4) | 5524 (67.0)     | 2717 (33.0) | 5260 (73.1)     | 1935 (26.9) | 7563 (73.9)     | 2669 (26.1) |
| <b>Women</b> | 2311 (47.7)     | 2538 (52.3) | 2622 (58.5)     | 1860 (41.5) | 2579 (66.5)     | 1299 (33.5) | 3682 (69.0)     | 1652 (31.0) |
| <b>Men</b>   | 2816 (69.5)     | 1236 (30.5) | 2902 (77.2)     | 857 (22.8)  | 2681 (80.8)     | 636 (19.2)  | 3881 (79.2)     | 1017 (20.8) |
| <b>Women</b> |                 |             |                 |             |                 |             |                 |             |
| Age          |                 |             |                 |             |                 |             |                 |             |
| 70–74        | 1141 (51.0)     | 1098 (49.0) | 1124 (67.5)     | 542 (32.5)  | 1052 (74.7)     | 356 (25.3)  | 1660 (77.2)     | 489 (22.8)  |
| 75–79        | 726 (47.6)      | 799 (52.4)  | 854 (58.3)      | 612 (41.7)  | 818 (68.6)      | 374 (31.4)  | 1091 (72.5)     | 413 (27.5)  |
| 80–84        | 316 (40.2)      | 470 (59.8)  | 453 (51.1)      | 434 (48.9)  | 479 (57.9)      | 349 (42.1)  | 544 (60.5)      | 355 (39.5)  |
| 85+          | 128 (42.8)      | 171 (57.2)  | 191 (41.3)      | 272 (58.7)  | 230 (51.1)      | 220 (48.9)  | 387 (49.5)      | 395 (50.5)  |
| Lives alone  |                 |             |                 |             |                 |             |                 |             |
| No           | 1579 (60.9)     | 1014 (39.1) | 1452 (80.9)     | 342 (19.1)  | 1479 (84.4)     | 274 (15.6)  | 2482 (85.1)     | 435 (14.9)  |
| Yes          | 692 (31.9)      | 1474 (68.1) | 852 (40.8)      | 1238 (59.2) | 844 (50.2)      | 838 (49.8)  | 1183 (49.6)     | 1202 (50.4) |
| <b>Men</b>   |                 |             |                 |             |                 |             |                 |             |
| Age          |                 |             |                 |             |                 |             |                 |             |
| 70–74        | 1464 (74.4)     | 504 (25.6)  | 1391 (82.7)     | 291 (17.3)  | 1151 (84.3)     | 214 (15.7)  | 1761 (82.9)     | 364 (17.1)  |
| 75–79        | 842 (67.7)      | 401 (32.3)  | 924 (76.6)      | 283 (23.4)  | 837 (82.3)      | 180 (17.7)  | 1188 (81.9)     | 262 (18.1)  |
| 80–84        | 381 (63.0)      | 224 (37.0)  | 415 (72.6)      | 157 (27.4)  | 514 (76.5)      | 158 (23.5)  | 626 (78.0)      | 177 (22.0)  |
| 85+          | 129 (54.7)      | 107 (45.3)  | 172 (57.7)      | 126 (42.3)  | 179 (68.1)      | 84 (31.9)   | 306 (58.8)      | 214 (41.2)  |
| Lives alone  |                 |             |                 |             |                 |             |                 |             |
| No           | 2515 (78.3)     | 695 (21.7)  | 2352 (90.6)     | 243 (9.4)   | 2139 (90.8)     | 217 (9.2)   | 3458 (89.5)     | 406 (10.5)  |
| Yes          | 281 (34.7)      | 528 (65.3)  | 264 (34.6)      | 498 (65.4)  | 229 (40.8)      | 332 (59.2)  | 410 (40.7)      | 597 (59.3)  |

\* The variable 'Feeling lonely' (No/Yes) was slightly different in HUNT1 versus HUNT2-4. In HUNT1, respondents answered the question 'Do you often feel lonely?' with one of the following five responses: 1. 'very often' (4.2%), 2. 'often' (6.3%), 3. 'sometimes' (32.0%), 4. 'very rarely' (24.8%) and 5. 'never' (32.8%). Response 1-3 were considered 'Yes' for the variable 'Feeling lonely' while responses 4-5 were considered 'No'. In HUNT2-4, 'Feeling lonely' (No/Yes) was assessed by the question 'In the last 2 weeks, have you felt lonely?', with the following four responses: 1. 'no', 2. 'a little', 3. 'a good amount' and 4. 'very much'. Responses 2-4 were considered 'Yes' for the 'Feeling lonely' variable while response 1 was considered 'No'. The prevalence of each original item in HUNT2 was 1. 'no' (67.0%), 2. 'a little' (21.6%), 3. 'a good amount' (8.1%) and 4. 'very much' (3.3%); in HUNT3, the prevalence was 1. 'no' (73.1%), 2. 'a little' (19.6%), 3. 'a good amount' (5.5%) and 4. 'very much' (1.2%); in HUNT4, the prevalence was 1. 'no' (73.9%), 2. 'a little' (20.3%), 3. 'a good amount' (4.6%) and 4. 'very much' (1.2%).

70–79 years old (Fig. 3).

The prevalence of loneliness was standardized by age and sex for each survey. Thus, differences in age and sex between single and non-single households should not impact differences in loneliness according to living situation. However, since the standardization was done for each survey, the time trends in loneliness could still be confounded by differences in the age and sex composition over time. Therefore, we did an additional analysis with adjustments for age, sex, and living situation. On average, the standardized prevalence of loneliness decreased by 5.3 percentage points between each of the four surveys (95% CI 4.9, 5.8). Adjusting for age and sex decreased this to 5.0 percentage points (95% CI 4.6, 5.4), and further adjusting for living situation lowered the reduction to 4.5 percentage points (95% CI 4.2, 4.9). Thus, 15% of the decrease in the prevalence of loneliness over time could be ascribed to age, sex, and living situation.

HUNT1 differed from HUNT2–4 both in terms of the loneliness question and in terms of response rates, while HUNT2–4 had identical loneliness questions and similar response rates. In a sub analysis, we excluded HUNT1 and investigated time trends across HUNT2–4. In HUNT2–4, the standardized prevalence in loneliness decreased by an average of 3.0 percentage points (95% CI 2.4, 3.6) between each study wave. Adjustment for age and sex did not affect the results (3.0, 95% CI 2.4, 3.6), while further adjustment for living situation reduced the decline in loneliness between each study wave to 1.2 percentage points (95% CI 0.6, 1.8). Thus, the reduction in single households from 1995 to 2019 could account for 60% of the decline in loneliness during that period.

Statistics Norway estimates that the number of older adults aged 70 years and above will increase from 666,544 in 2020 to 768,743 in 2025, and to 982,545 in 2035 (Fig. 4). Applying the standardized age- and sex-specific prevalence of loneliness in our data from HUNT4, the total number of older adults experiencing loneliness in Norway is projected to

increase from about 184,000 in 2020 to 212,000 in 2025, to 286,000 in 2035 and to 380,000 in 2050 (Fig. 4).

### 3.1. Sensitivity analyses

In HUNT4, respondents had the opportunity to be interviewed at home if they had difficulties meeting at the examination station. Those who performed the interviews at home (H) in HUNT4 ( $n = 576$ ) were older (86.2, SD 6.9) than those who performed the interviews at the testing station (S) (76.5, SD 5.3 years), and they were mostly women (H:69%, S:51%) living in single households (H: 73%, S:31%) and had a larger prevalence of loneliness (H:56%, S:25%). Both groups (H and S) were included in the current sample; however, in a sensitivity analysis wherein the home-based interviews were excluded, the overall prevalence of loneliness was lower (24.7% versus 26.1% in the full sample). Nonetheless, the time trends and results in Figs. 1-3 were very similar in the two settings. Nursing home residents were included in HUNT1 and 4, but not in HUNT2 and 3. To allow for fair comparisons across all surveys, nursing home residents were therefore excluded from our study population, and results are based on home-dwellers only. However, in a setting where nursing home residents were included, the crude prevalence of loneliness in HUNT1 increased from 42.4% to 43.8% (an increase from 30.5% to 32.4% among men and from 52.3% to 53.2% among women). In our analyses, those living at nursing homes in HUNT4 were excluded ( $n = 240$ ). When these were included, the crude prevalence of loneliness increased from 26.1% to 27.0% (an increase from 20.8% to 21.5% among men and from 31.0% to 31.9% among women). Overall, these analyses suggest that our results are robust in relation to inclusion or exclusion of home-based interviews and nursing home residents.

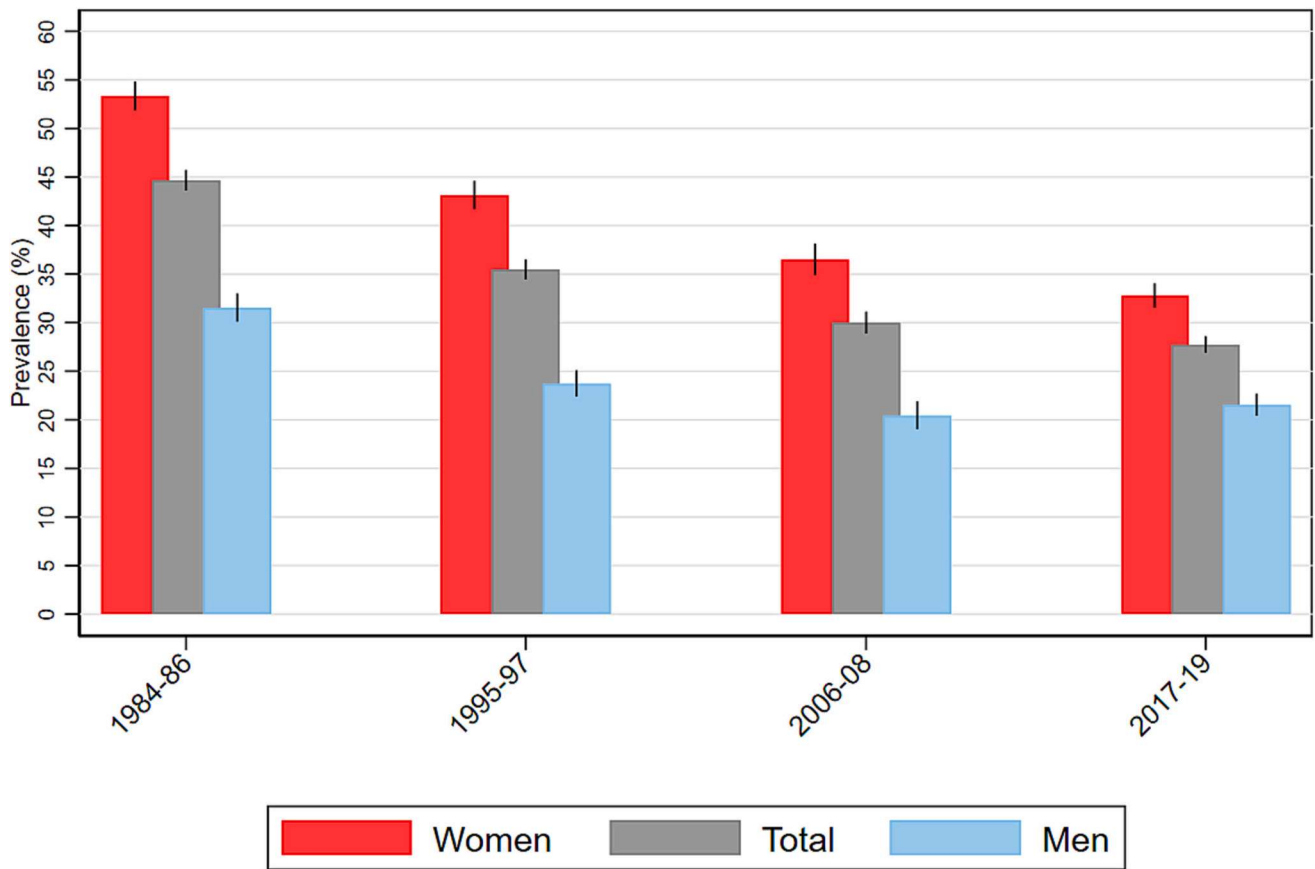


Fig. 1. Prevalence of loneliness (%) by sex with 95% confidence intervals. Standardized by age and sex for each survey using the Norwegian population the current year as standard population.

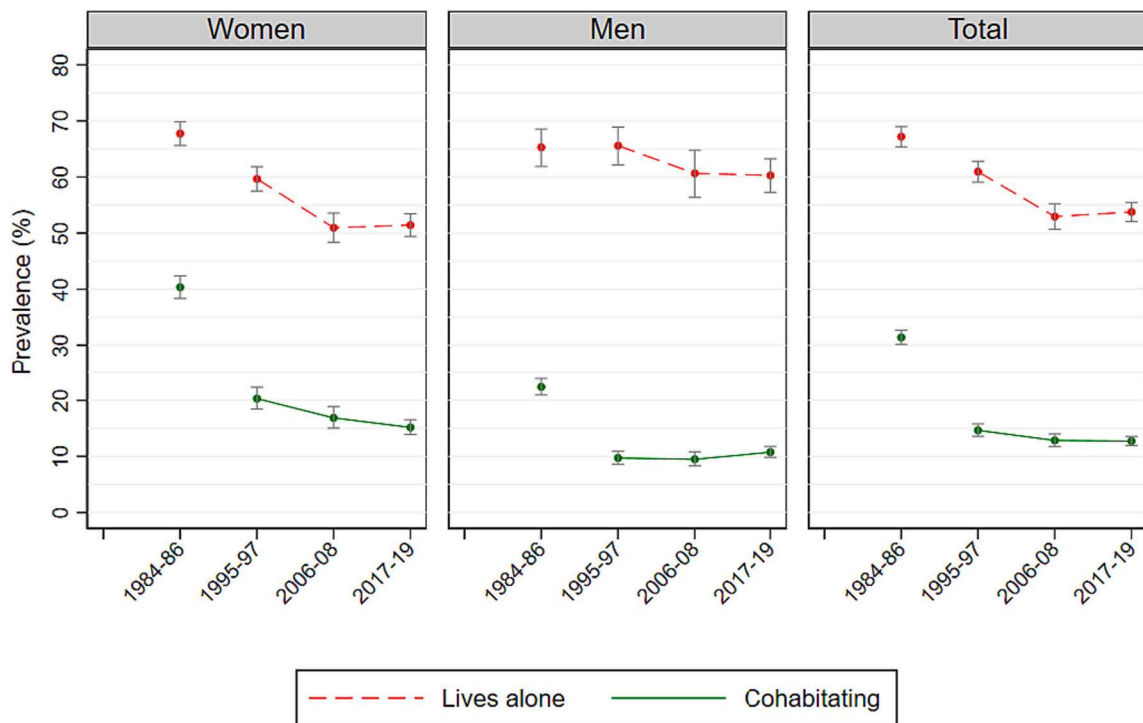


Fig. 2. Prevalence of loneliness (%) by living situation and sex with 95% confidence intervals. Standardized by age and sex for each survey using the Norwegian population the current year as standard population.

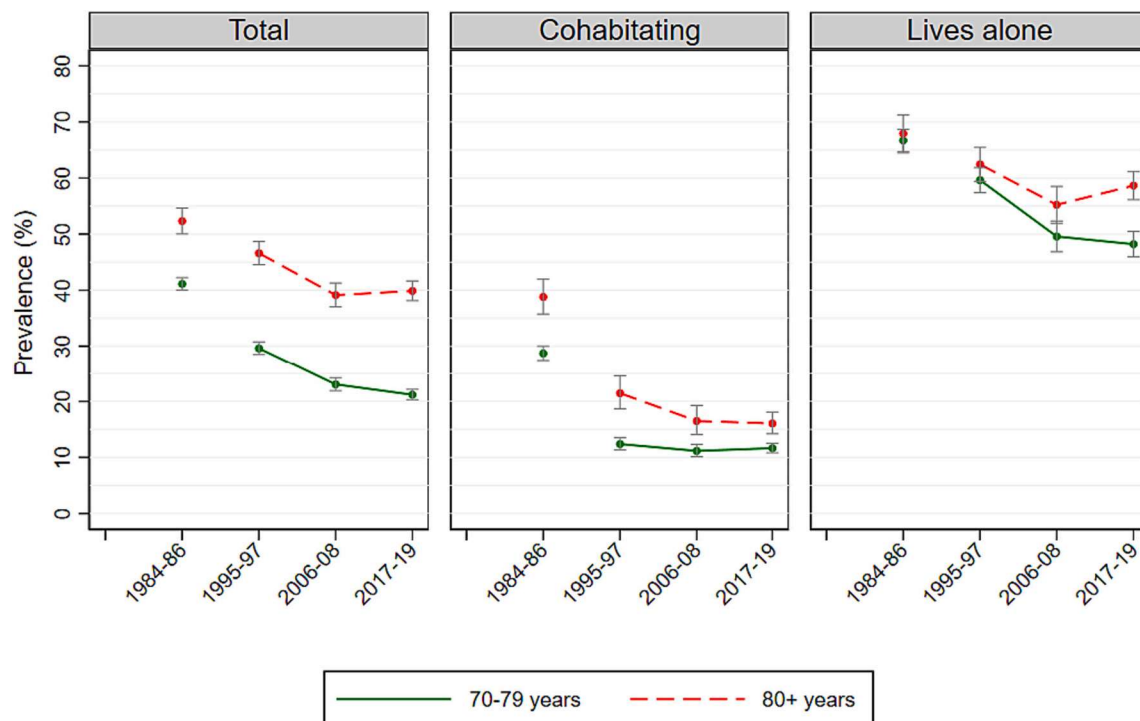


Fig. 3. Prevalence of loneliness (%) by age and living situation with 95% confidence intervals. Standardized by age and sex for each survey using the Norwegian population the current year as standard population.

#### 4. Discussion

To our knowledge, this is the first large population-based study to investigate time trends in loneliness over more than three decades by sex, age, and living situation. In this study of 27,032 home-dwelling Norwegians aged 70 years and older, the prevalence of loneliness declined from 1984 to 2019. Initially, this decline was mainly independent of compositional differences in age, sex, and single households between the surveys, but the reduction in single households could explain much of the decline in loneliness after 1995. Our finding of declining prevalence in loneliness among adults aged 70 years and older is in line with previous studies from Finland, the Netherlands, Germany and the US (Eloranta et al., 2015; Nicolaisen et al., 2022; Suanet and van Tilburg, 2019; Surkalim et al., 2023), while others from Sweden, the Netherlands, and also the US, reported stable prevalence over time (Dahlberg et al., 2018; Hawkey et al., 2019; Vlaming et al., 2014). Comparable research on time trends from other countries is lacking.

The reported reduction in single households during 1995–2019 in our study coincided with a decrease in loneliness. However, the magnitude and significance of this association is unclear due to the simultaneous occurrence of several other significant societal changes in Norway over these decades, which may have influenced the observed reduction in loneliness among older adults. The decline might potentially be attributed to an increased proportion of older people possessing higher educational attainment, financial wellbeing, health, and living conditions. For investigations on causal mechanisms, the inclusion of a wide range of mediators and the use of mediation analysis are required, which is beyond the scope of the present paper. Hence, future research aimed at disentangling the mechanisms involved in time trends in loneliness among older adults is needed to inform policy and preventive measures.

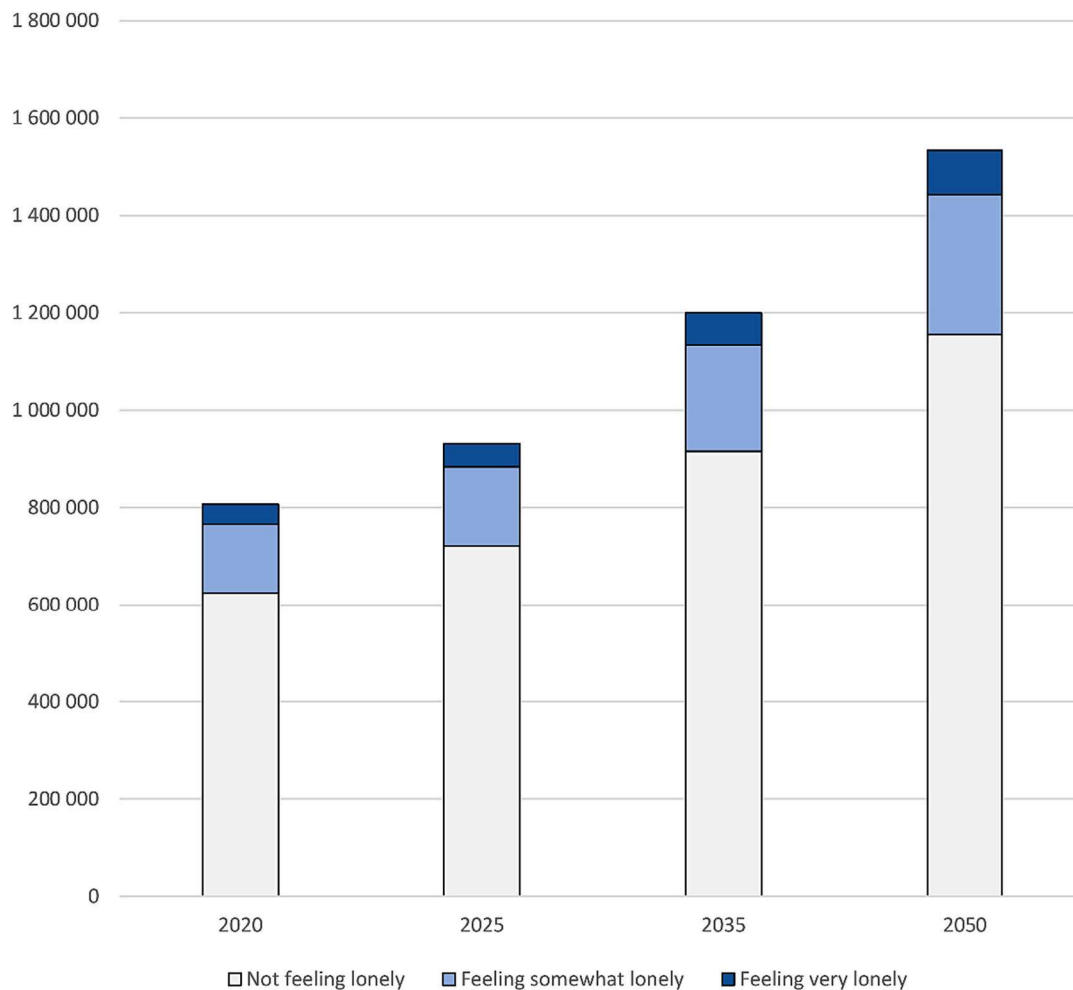
Although the overall trend of loneliness declined among adults aged 70 years and older in this study, there were some exceptions. The increasing trends in loneliness among adults aged 80+ between the two most recent surveys are noteworthy and diverges from the similar previous studies (Nyqvist et al., 2017; Surkalim et al., 2023; Timmermans

et al., 2019). Moreover, older adults living alone had a substantially higher prevalence of loneliness than those living with someone. In the most recent survey in 2017–19, as much as 59% of the women living alone compared to 15% of those living with someone, and 50% of the men living alone compared to 11% of those living with someone, reported having feelings of loneliness. This aligns with other Nordic studies, which found that living alone, especially when combined with poor health, is the strongest predictor of loneliness (Eloranta et al., 2015; Nicolaisen et al., 2022) and that loss of partner is an important factor (Dahlberg et al., 2018).

In our study we focused on standardized prevalence estimates. However, the choice between crude values, age- and sex adjusted values or standardized values had minimal impact. The crude prevalence of loneliness was 2–3 percentage points higher than the standardized estimates, largely due to higher dropout rates in the higher age groups and thereby lower weighting for these age bands in the overall estimates.

Our study also suggests a higher number of lonely older adults in Norway in the future. The estimated number of older adults experiencing loneliness in Norway is expected to increase from about 184,000 in 2020 to 286,000 in 2035 and to 380,000 in 2050, and the number of old adults experiencing severe loneliness is predicted to increase from approximately 41,000 in 2020 to 90,000 in 2050. Loneliness is associated with detrimental health consequences (Kang and Oremus, 2023; Leigh-Hunt et al., 2017; Park et al., 2020; Rico-Uribe et al., 2018; Valtorta et al., 2016) and an increase in the number of older people feeling lonely may have a substantial impact on the need for health services among old people in the future, particularly for those experiencing severe loneliness. Moreover, a recent study have found that both feeling lonely and being socially isolated, especially in combination, are associated with a decreased in years expected to be spent in cognitive healthy conditions (Li et al., 2023). These findings underscore the importance of implementing social and policy initiatives designed to foster social connectivity among older adults (Hawkey and Kocherginsky, 2018).

Limitations of this study should be mentioned. The loneliness prevalence reported in this paper may differ from other studies due to



**Fig. 4.** Projected number of people aged 70 years and older not feeling lonely, feeling somewhat lonely ('a little') and feeling very lonely ('a good amount', and 'very much') from 2020 to 2050\*.

\* Projections were calculated using the standardized prevalence of loneliness in HUNT4 based on the standard populations in 2019 by age (70–74, 75–79, 80–84, 85+) and sex. Population estimates and projections from Statistics Norway by age and sex for years 2020, 2025, 2035 and 2050 were used to estimate the number of persons aged 70 years and older in Norway feeling lonely (and not feeling lonely).

differences in the categorisation of 'lonely' and 'not lonely'. A general weakness within research on loneliness is that comparison between studies is limited due to differences in assessment methods and sample characteristics. In this study, loneliness was assessed differently in HUNT1 than in the three following surveys, which means that comparisons of HUNT1 with the later surveys should be done with caution. Moreover, the participation rates of the HUNT surveys declined from HUNT1 to HUNT3 but were similar in HUNT3 and HUNT4 (Åsvold et al., 2021). Well-known risk factors were not examined, such as health status including depression and functional health status. During the last decades the health of older people has improved and this may also have contributed to a decline in loneliness (Aunsmo and Holmen, 2017).

Projections of loneliness prevalence are uncertain and rest on certain assumptions. We assume that age-, sex- and education specific prevalence of loneliness are fixed at 2017–19 levels and remain unchanged over time. However, we allow the age and sex structure to change according to Statistics Norway's population forecasts. Consequently, our projections primarily reflect how an aging population influences on loneliness prevalence, which we believe still offer valuable insights for healthcare and social service planners. Non-participation bias may have caused underestimations, particularly in HUNT2–4. However, the effects may be quite alike for each of the three latter survey rounds since the participation rates were relatively similar. Although comparisons of loneliness assessed at HUNT1 with the latter survey rounds is limited

due to the use of a different measurement and a higher participation rate (less risk of underestimation), loneliness reported in HUNT2–4 constitutes robust sources of comparisons and trend analysis.

## 5. Conclusion

Overall loneliness among people 70 years and older in Norway declined from 1984 to 2019, dropping from 42.4% to 26.1%, whereas the most severe categories of loneliness (a good amount, very much) dropped from 11.4% in 1995 to 5.8% in 2019. This decrease may partially be explained by a reduction in single-person households, along with other substantial changes that have occurred within the older population throughout the study period. In all assessments, the prevalence of loneliness was higher among women, the oldest and those living alone. However, in light of demographic shifts, the absolute number of older adults experiencing loneliness is projected to increase in the future. Projections suggest that from year 2020 to 2050, the estimated number of older adults in Norway suffering from loneliness could potentially surge from a total of approximately 184,000 to 380,000, including an increase from 41,000 to 90,000 individuals experiencing severe loneliness, which will probably lead to a rise in the need for health care services.

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## CRediT authorship contribution statement

**Ellen Melbye Langballe:** Conceptualization, Methodology, Investigation, Writing – original draft, Writing – review & editing. **Ragnhild Holmberg Aunsmo:** Conceptualization, Methodology, Investigation, Writing – original draft, Writing – review & editing. **Thomas Hansen:** Conceptualization, Methodology, Writing – original draft, Writing – review & editing. **Geir Selbæk:** Conceptualization, Methodology, Writing – original draft, Writing – review & editing. **Bjørn Heine Strand:** Conceptualization, Methodology, Formal analysis, Investigation, Visualization, Writing – original draft, Writing – review & editing.

## Declaration of Competing Interest

The authors declare that they have no known competing interests.

## Data availability

Data from the HUNT Study used in research projects are available upon request to the HUNT Data Access Committee (hunt@medisin.ntnu.no) to research groups who meet the data availability requirements

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