Title page

"Where are all the lonely people?"

A population-based study of high-risk groups across the life span

Mathias Lasgaard[1,2]

Email: mathias.lasgaard@stab.rm.dk

Karina Friis[1]

Email: karina.friis@stab.rm.dk

Mark Shevlin[3]

Email: m.shevlin@ulster.ac.uk

[1] DEFACTUM, Central Denmark Region, Aarhus, Denmark

[2] Department of Psychology, University of Southern Denmark, Odense, Denmark

[3] Department of Psychology, Ulster University, Londonderry, Northern Ireland

Corresponding author: Mathias Lasgaard, Olof Palmes Allé 15, 8200 Aarhus N, e-mail: mathias.lasgaard@stab.rm.dk , +45 24781157

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Abstract

Background

Loneliness is a prevalent and urgent public health issue. Optimal planning of community approaches to loneliness requires a differentiated understanding of loneliness across the life span. We identified groups at high risk of loneliness by exploring the relationship between loneliness and socio-demographic and health-related factors across multiple age groups.

Methods

This was a combined population-based questionnaire survey and register data study based on a representative sample including 33,285 Danish individuals aged 16-102 years. Loneliness was measured using the Three-Item Loneliness Scale.

Results

The relation between loneliness and age took a shallow U-shaped distribution. Ethnic minority status, receiving disability pensions or being unemployed, living alone, prolonged mental disorder and psychiatric treatment were strongly associated with severe loneliness. Socio-demographic and health-related factors were associated with an increased risk of severe loneliness in specific age groups. Being female, having a low educational level, and living in a deprived area were only associated with loneliness in adolescence/emerging adulthood. Receiving disability pensions and living alone (i.e., divorced), on the other hand, were strongly associated with loneliness in early and middle adulthood and young-old age.

Conclusion

Ethnic minority status, living alone and prolonged mental disorder may well be key factors in determining the generic level of loneliness in a given population. Other conditions are associated with an increased risk of severe loneliness in specific age groups and may moderate the age-loneliness relation. These findings may help identify populations within

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communities at risk of loneliness and thereby support the implementation of policies and

public health interventions across the life span.

Introduction

Contemporary life in developed countries seems to increase the risk of loneliness, i.e. a negative, distressing emotional response to a discrepancy between one's desired and actual social relationships (1). Loneliness is not synonymous with social isolation (or solitude), but is related to both the amount of social contact (quantity) as well as to the features (quality) defining social relationships, as for instance intimacy and trust. Hence, it is of concern that the number of Americans with no close confidants almost tripled from 1985 to 2004 (2), and that the most common household type in 2014 in the European Union was a single person living alone (3).

Moreover, a growing body of longitudinal research indicates that loneliness predicts mental and physical health problems, including depressive symptoms (4, 5), poor sleep quality (6), increased systolic blood pressure (7), altered immunity (8) and increased vulnerability to stroke, heart failure and coronary heart disease (9, 10). In fact, the strength of loneliness as a predictor of mortality rivals that of well-established clinical risk factors like physical inactivity and obesity (11). Although the amount of research is limited, loneliness has also been associated with health-care utilisation, including visits to general practice (12) and use of outpatient services (13). Loneliness is, indeed, a prevalent and urgent public health issue. Yet, the health-related risks of loneliness remain unrecognised or overlooked by many public health officials and institutions (14).

Moreover, there is a strong social stigma about loneliness. Accordingly, organisations providing interventions to reduce loneliness often have difficulty identifying, reaching and recruiting lonely people (15, 16). Therefore, the identification of high-risk groups is a relevant research aim that may aid the development and delivery of targeted interventions.

Population-based loneliness research has so far focused on specific populations, especially elderly high-risk groups (17), and has informed prevention and intervention efforts (18). Rather less attention has been devoted to studying the prevalence of loneliness and variation in loneliness in other age groups in nationally representative samples. Little is therefore known about high-risk groups across different stages of the life span (17, 19).

Moreover, previous studies report inconsistent results concerning the relationship between loneliness and age (17, 20). Yang and Victor (21) described two generic models of this relationship. The first model rests on the common assumption that the risk of loneliness increases in old age because conditions associated with loneliness occur more frequently with growing age (e.g., retirement, chronic health problems, loss of spouse and long-term care) (21). Hence, the first model describes a linear relation between loneliness and age with a progressive age-related increase across the life course. The second model echoes both theoretical approaches to loneliness that assign special importance to adolescence (22) and the findings of a study from New Zealand which suggests that loneliness rates may be elevated in both adolescence and old age (23). Accordingly, the second model describes a non-linear U-shaped relationship between loneliness and age with high rates of loneliness among young people and elderly people.

A recent national study of 2,393 British adolescents and adults (aged 15-97 years) by Victor and Yang (17) supported a U-shaped relation with those under 25 years and over 65 years reporting the highest loneliness levels. Moreover, this novel study suggested noteworthy differences in the prevalence of loneliness across three age groups (i.e., 'young adults', 'midlife adults', and 'older adults') in relation to marital status, educational status and self-reported health. The study hence clearly supported Rook's (24) notion that there is a need for

a differentiated understanding of loneliness across the life span to optimize the planning of public health and community approaches. However, Victor and Yang's study (17) had a modest sample size and used a single-item question to measure loneliness, associated with other methodological shortcomings (25).

Studies of specific age groups have reported mixed findings concerning the relationship between loneliness and common socio-demographic factors such as gender (26, 27), ethnicity (28-31) and education (32, 33), whereas marriage/cohabitation consistently has been found to protect against loneliness (34, 35). The findings from these studies testify the relevance of using population-based data to identify high risk groups across the life span with the aim to support the development of targeted interventions. However, to the best of our knowledge only Victor and Yang (17) have systematically investigated the relationship between loneliness and several important socio-demographic factors across various age groups. Aiming to expand on the existing literature and to remedy some of the shortcomings of Victor and Yang's study, the present paper reports on a large-scale population-based study of the prevalence of severe loneliness (measured by a validated scale) across the life span. We examine five different age groups and a range of socio-demographic and health-related indicators. Hence, the study may put the two models describing the relation between age and loneliness to a test, identify high-risk groups across different stages of the life span and ultimately help analysts, programme developers and policy planners aiming to reach and help lonely people.

Methods
Study design and data collection

Data were drawn from the 2013 Danish National Health Survey ("How Are You?"). The present study comprises data from the Central Denmark Region, one of the five Danish administrative regions, which is home to approximately 23% of the Danish population of 5.7 million inhabitants. The study population's demographic composition (sex, age, and civil status) is similar to that of the total Danish population (36). A total of 54,300 randomly selected (county-stratified) individuals were invited to participate in the survey. Participants either filled in an enclosed questionnaire or completed the questionnaire on-line. Three reminders were issued. The final sample consisted of 33,285 individuals aged 16 to 102 years representing a 61% response rate. The study was approved by the Danish Data Protection Agency (r. no. 2012-58-0006). The participants were informed in writing about the purpose of the survey and their voluntary completion and return of the survey questionnaires constituted implied consent.

Variables

All citizens in Denmark have a unique and permanent personal identification number, which allowed us to link survey data to relevant register data at the individual level (37).

Loneliness

Survey data on loneliness were collected using a Danish version of the Three-Item Loneliness Scale (TILS) (38, 39), developed with reference to large population-based surveys. The scale is based on the UCLA Loneliness Scale (UCLA) (40), the gold standard measure in loneliness research. The TILS correlates strongly with the UCLA ($r = .82$), and it has demonstrated good internal consistency ($\alpha = .72$ in this sample) and high concurrent and discriminant validity (38). Items are rated on a three-point Likert scale (hardly ever, sometimes, and often) and the sum of the items constitutes a global measure of loneliness

with higher scores indicating greater loneliness. Different methods for identifying greater loneliness, or caseness, have previously been used: the cut-off score for the upper tenth or the upper quintile, and scores exceeding 4, 6 and 7. In accordance with recent studies (41, 42), the highest value was used, in this case 7, to get a conservative estimate of severe loneliness. Moreover, a score of 5 or 6 on TILS defined moderate loneliness. It should be noted that the TILS does not specify the time-period in question. Hence, it is not possible to distinguish between prolonged and transient loneliness. As recommended, cases were dropped prior to data analysis if more than one item was missing on the scale (43).

Socio-demographic factors

In order to systematically identify high-risk groups across the life span, a broad range of socio-demographic factors were included: age (register data), gender (register data), ethnic status (register data), educational level (survey data), employment status (survey and register data), cohabitation status (survey and register data), parental status (survey data), housing status (survey data), urbanisation (survey data) and residential area (register data). Register data were derived from the Danish Civil Registration System (37) and the Danish Register for Evaluation of Marginalisation (44). Danish ethnicity was defined as having a Danish citizenship or at least one parent with a Danish citizenship. Using the Danish version of The International Standard Classification of Education, we categorised educational level as low (1-10 years), medium (11-14 years) and high (>15 years). Students were categorised in accordance with the expected graduation level. Employment status was classified into five categories; working, enrolled in education, unemployed, disability pensions and retirement. The group of unemployed people included individuals who could not be included into the other categories. Individuals who self-reported to be living with a partner or registered as married were categorised as living with a partner, whereas individuals who self-reported that

they were single were categorised as divorced, widowed or never married. In the age group 16 to 25 years, individuals were further classified as living with a partner if they had been with a partner for at least a year. Statistics Denmark provided parish-level data from year 2012. Deprived areas were defined as parishes with a low average income, a high number of unemployed and a large number of individuals with a low level of education.

Health-related factors

Five health-related factors were included.

General practitioner (GP) contacts (register data): We obtained information about the total number of contacts with a GP in 2012 from the Danish National Health Service Register (45). A greater number of contacts was defined as a total number within the upper 10th percentile (unweighted data), corresponding to 30 or more physical consultations and/or e-mail/phone consultations in 2012.

Life-threatening somatic condition (survey data): Data on diseases were collected using an instrument recommended by the World Health Organisation for use in national health surveys (46). Respondents were asked if they had any of five long-term conditions (i.e., myocardial infarction, angina pectoris, stroke, chronic obstructive pulmonary disease and cancer) or if they were still affected by myocardial infarction, angina pectoris or stroke. If so, they were categorised as having a 'life-threatening somatic condition'.

Somatic hospital admissions (register data): We obtained information about number of hospitalisations in a somatic department from the Danish National Patient Register (NPR) (47). Somatic hospital admission was defined as at least 1 admission in 2012.

Prolonged mental disorder (survey data): Participants were asked if they had a mental disorder lasting more than 6 months at the time of the data collection.

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Psychiatric treatment (register data): We obtained information about number of hospitalisations and outpatient treatments in a psychiatric department from the NPR (47). Psychiatric treatment was defined as at least 1 admission, outpatient treatment, or treatment at the emergency department in 2012.

Data analysis

The response rate was rather low among young men, the oldest elderly and individuals with a different ethnic background than Danish. To enhance the representativeness of the study population, sampling weights were applied to account for potential differences in selection probabilities and response rate. These weights were constructed by Statistics Denmark using a model-based calibration approach (48) based on register information on responders and non-responders (i.e., sex, age, municipality of residence, social background and healthcare utilisation).

We calculated the prevalence of moderate and severe loneliness for the total sample across the life span. Multinomial logistic regression (MLR) analyses were conducted at the population level with the variables representing moderate and severe loneliness (reference category: non-lonely). The analysis investigated the association between the socio-demographic and health-related factors and moderate and severe loneliness. Moreover, binary logistic regression (BLR) analyses were conducted for the five distinct age groups with severe loneliness as the dependent variable. The BLR analysis investigated the association between the socio-demographic and health-related factors and loneliness. The results of the MLR and BLR analyses are presented as unadjusted odds ratios (bivariate association) and adjusted (AOR) for the remaining predictors. To ensure sufficient power, we used broad age categories as proxies for life stages: 16-29 years being 'adolescence/emerging adulthood', 30-44 years being 'early adulthood', 45-59 years being 'middle adulthood', 60-74 years being

'young-old age', and 75+ years being 'middle-old/old-old age'. Some socio-demographic and health-related conditions were very rare or did not occur in specific age groups (e.g., very few participants were living alone due to widowhood or divorce in adolescence/emerging adulthood and very few were still working in the middle old/old-old age group), causing unstable estimates or empty cells (< 100 cases). Therefore, some figures are not reported on ethnicity, employment status, cohabitation status, life-threatening somatic conditions, life-threatening somatic conditions, prolonged mental disorder and psychiatric treatment. Statistical analyses were performed using STATA version 13.

Results

Descriptive statistics are presented in Table 1. A total of 4.6% (CI: 4.3-4.9%) of the population was classified as severely lonely and 16.4% (CI: 15.8-16.9%) as moderately lonely. The prevalence of moderate and severe loneliness across the life span is presented in Figure 1. The overall relationship with age formed a shallow U-shaped distribution in which the highest levels of moderate and severe loneliness were seen for adolescence, emerging adulthood and old-old age. This distribution was most evident for moderate loneliness. The lowest level of moderate and severe loneliness was reported in young-old age. Table 2 shows the results of the MLR analysis. At the bivariate level, all socio-demographic and health-related factors, except urbanization, were associated with severe loneliness. Ethnic minority status (i.e., other Western countries) and prolonged mental disorder demonstrated the strongest relations with severe loneliness when adjusting for the remaining factors (i.e., AOR > 4). Furthermore, ethnic minority status, receiving disability pensions or being unemployed, living alone and psychiatric treatment were all strongly associated with severe loneliness (i.e., AOR > 2). Parental status, more contact with a GP and hospital admission (somatic

department) were not associated with severe loneliness at the population level when adjusting for the remaining factors.

All socio-demographic and health-related factors were associated with moderate loneliness at the population level. Overall, the associations with moderate loneliness were similar to those found for severe loneliness, although the former tended to be weaker. Adjusting for the remaining factors, ethnic minority status, living alone (i.e., widowed) and prolonged mental disorder were strongly associated with moderate loneliness (i.e., AOR > 2). Educational level, parental status and hospital admission (somatic department) were not associated with moderate loneliness at the population level when adjusting for the remaining factors.

Table 3 shows the results of the BLR analysis. Examining the prevalence across the five age groups, we found that ethnic minority status (i.e., other Western country), unemployment and prolonged mental disorder were strongly associated with severe loneliness in all age groups except middle-old/old-old age (few cases), even when adjusting for the remaining factors (AOR > 2). Living alone (i.e., never being married) was also associated with severe loneliness in all age groups except middle-old/old-old age (AOR = 1.5-2.8). Noteworthy, the remaining variables were associated with loneliness only in specific age groups. Female gender, a low or medium educational level and living in a deprived area were associated with loneliness only in adolescence/emerging adulthood (AOR = 1.5-2.4). Receiving disability pensions and living alone (i.e., divorced), on the other hand, were strongly associated with loneliness in early and middle adulthood and young-old age (AOR > 2). Moreover, living in a village/the countryside was associated with loneliness only in young-old age, whereas life-threatening somatic conditions and somatic hospital admission were associated with loneliness in middle adulthood only (AOR = 1.6-2.2).

Also noteworthy, a low educational level and a greater number of contacts with a GP were associated with loneliness in all five age groups; but when adjusting for the remaining

factors, only a low educational level in adolescence/emerging adulthood remained associated with severe loneliness.

Discussion

In this study of 33,285 Danes, 4.6% were classified as severely lonely and 16.4% as moderately lonely. The relation between loneliness and age took a shallow U-shaped distribution that was most evident for moderate loneliness and among severely lonely women. Our overall findings partly confirm those reported in a previous European cross-cultural study indicating that Northern European countries (including Denmark) have low loneliness prevalence rates with a largely shallow age-related pattern across all age levels except for those above 70 years (21).

To our knowledge, the present study is the first large-scale population-based study evaluating the relationship between the prevalence of severe loneliness and a broad range of indicators across five different age groups. Overall, the study demonstrated strong associations between socio-demographic and health-related factors and loneliness. Yet, importantly, some conditions were associated with severe loneliness across the life span, whereas others carried this risk in specific age groups only.

Ethnic minority status, living alone and prolonged mental disorder were associated with severe loneliness across all five age groups except middle-old/old-old age and may well be key factors in determining the generic level of loneliness in a given population. As Denmark has seen an increase in immigration, single households, and divorces (49), and a slightly negative development in overall mental health (50) over the past decades, we speculate that the prevalence of loneliness may escalate in the future.

The present study may also inform other important loneliness issues. Loneliness has been described as a consequence of both modern urban life and rural life in remote areas. We found that living in a village or in the countryside carries an increased risk of severe loneliness, yet only in young-old age. Moreover, loneliness has been associated with low educational attainment in some previous studies (17, 33). Yet, when adjusting for employment status, living conditions and other indicators, that association was not confirmed except in adolescence/emerging adulthood. Hence, low educational attainment may not be associated with severe loneliness in adulthood/old age as long as you are employed and/or living with a partner. Overall, these findings suggest that the age-loneliness relation is likely to be moderated by other socio-demographic factors.

A larger number of contacts with a GP was associated with severe loneliness in all five age groups. However, in accordance with previous studies (51, 52), the association become non-significant when adjusting for the remaining factors, including health status (i.e., life-threatening somatic conditions and prolonged mental disorder). Similarly, loneliness was found not to be associated with hospital admission (somatic department) regardless of socio-demographics and health status in four out of five age groups. Yet, in middle adulthood severe loneliness was directly linked to hospital admission. To our knowledge, no prior studies have examined the association between loneliness and hospital admission in different age groups; this novel finding therefore requires replication in other samples. Nevertheless, the present study suggests that poor health (rather than loneliness/social problems *per se*) is likely to explain lonely people's higher frequency of health-care utilisation except in middle adulthood. In contrast, a few earlier studies suggest that there is a direct link between loneliness in old age and health-care utilisation, regardless of health status (53, 54).

Various mechanisms may explain our findings. Some indicators may be associated with loneliness at a generic level (e.g., genetics, social and cognitive deficits, cultural/societal

background or general living conditions), whereas others may be associated with loneliness at different stages of the life span. Weiss (55) argued that social needs have a different value in different phases of life. Being lonely with regard to different relationships may therefore be associated with deficits in different domains and may increase or decrease over time (56, 57). The link between some socio-demographic factors and health-related factors and severe loneliness may therefore vary across different age groups. For instance, a life-threatening somatic condition in middle adulthood may inhibit family life and social activities and cause an unexpected loss of employment status, whereas severe illness in old-old age is more normative and to some extent expected.

Several of our findings are in line with those reported by Victor and Yang (2012) (17), but a comparison is difficult. Firstly, we measured loneliness with the validated and widely used TILS, whereas Victor and Yang used a criticised single, self-labelling question about loneliness (25). Secondly, their study investigated three age groups based on a smaller data set, which increases the risk of type 1 errors. Even in the present large population-based study, some figures were not reported because conditions were very rare or did not occur in specific age groups.

Policy implications

The increased recognition of loneliness as a risk factor for adverse psychological and physical health outcomes has spurred interest in interventions to reduce loneliness. We hope that the present study may support policy implementation and public health interventions across the life span. The community benefits of targeted actions may include improvements in quality of life and health status and reduced demands for social and healthcare services.

Yet, the multifaceted nature of loneliness presents a complex challenge (58). Therefore, it is an important task to identify groups within communities that are at risk of, or suffer from,

loneliness. Indeed, the present study indicates that ethnic minority societies and mental health associations may give access to high-risk groups. Likewise, the present study underscores the relevance of developing structures and procedures ensuring the availability of services for unemployed citizens and disability pensioners, young people living in deprived areas and middle-aged with life-threatening somatic conditions. At present, available research indicates that social cognitively oriented interventions may be effective in alleviating loneliness, although more randomised controlled studies are needed (59).

Limitations

The present study has many strengths (e.g., the large, representative population-based sample), but it also has limitations, some of which relate to the use of a population-based sample and secondary data analysis. The response rate among the oldest old was rather low; and people who are institutionalised or hospitalised may not be adequately represented. Also, people who had limited Danish language skills may not have participated in the survey. This may have introduced selection and information bias. Yet, the population weights compensate for non-response and differences in selection probabilities. Moreover, the findings are based on cross-sectional data, which implies that no conclusions about temporality or causation can be made. Also, the TILS does not distinguish between prolonged and transient loneliness. Yet, a longitudinal study indicated that the scale scores remained rather stable over time (60). Future longitudinal research will have to clarify the impact of time effects. Finally, it should be stressed that the study was conducted in a Northern European country with a rather low prevalence of loneliness compared with Southern and Eastern European countries (21). Indeed, the reported findings may be culturally situated and therefore require replication in other cultures.

Conclusion

The health-related risks of loneliness remain overlooked by many public health institutions. Moreover, organisations providing interventions to reduce loneliness often have difficulty identifying and reaching lonely people. Population-based loneliness research has so far focused on specific populations, especially elderly high-risk groups, which has informed intervention efforts. Yet, little has been known about high-risk groups across the life span. We found that ethnic minority status, living alone and prolonged mental disorder may well be key factors in determining the generic level of loneliness in a given population. Moreover, other conditions (e.g., female gender, educational attainment, living in a deprived area and receiving disability pensions) are associated with an increased risk of severe loneliness in specific age groups and therefore likely to moderate the age-loneliness relation. These findings may help identify populations within communities at risk of loneliness and thereby support the implementation of policies and public health interventions across the life span while contributing with additional knowledge on the complexity of the loneliness-age association.

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"Where are all the lonely people?"

Table 1. Participant characteristics in the total population and in five different age groups

	Total population 16+ years (n = 33,285)		Adolescence/ emerging adulthood 16-29 years (n = 5,324)		Early adulthood 30-44 years (n = 6,590)		Middle adulthood 45-59 years (n = 9,410)		Young-old age 60-74 years (n = 8,874)		Middle old/ old-old age 75+ years (n = 3,087)	
	n	%[a]	n	%[a]	n	%[a]	n	%[a]	n	%[a]	n	%[a]
Loneliness												
Not lonely	25,882	79.1	3,754	71.6	5,199	78.6	7,519	80.2	7,326	86.2	2,084	80.8
Moderate lonely	4,529	16.4	1,115	22.0	989	16.8	1,252	15.5	809	11.0	364	15.0
Severe lonely	1,130	4.6	307	6.4	233	4.6	309	4.4	185	2.9	96	4.2
Sex												
Men	15,696	49.7	2,345	50.9	3,011	50.7	4,448	50.5	4,473	49.9	1,419	40.8
Women	17,589	50.4	2,979	49.2	3,579	49.4	4,962	49.6	4,401	50.1	1,668	59.2
Ethnicity												
Danish	31,457	91.0	4,906	88.2	6,031	87.5	8,863	90.9	8,631	95.5	3,026	97.5
Other Western countries	718	3.7	157	5.4	187	4.5	186	3.0	144	2.7	44	1.8
Non-Western countries	1,110	5.3	261	6.4	372	8.0	361	6.1	99	1.9	17	0.7
Educational level												
Low	6,134	18.4	724	13.6	500	8.6	1,386	16.2	2,222	26.1	1,302	48.0
Medium	17,000	51.1	2,929	51.0	3,400	51.2	5,182	54.9	4,460	51.6	1,030	37.6
High	9,128	30.6	1,549	35.4	2,556	40.3	2,665	28.9	1,933	22.4	425	14.4
Employment status												
Working	16,263	47.7	1,373	26.6	5,199	76.8	7,539	77.4	2,072	21.4	80	2.0
Enrolled in education	4,606	18.7	3,396	64.6	663	11.6	474	5.4	73	0.9	0	0.0
Unemployed	1,883	6.9	435	8.4	491	8.9	683	8.6	274	3.7	0	0.0
Disability pensions	1,071	4.0	14	0.4	144	2.8	571	8.5	342	5.3	0	0.0
Retirement	9,065	22.7	0	0.0	0	0.0	0	0.0	6,058	68.6	3,007	98.0
Cohabitation status												
Live with partner	24,521	66.1	2,211	40.6	5,588	79.2	7,937	78.2	7,100	73.6	1,685	44.5
Live alone (divorced)	1,785	6.1	7	0.1	262	4.7	659	9.4	715	10.8	142	5.4

"Where are all the lonely people?"

	n	%	n	%	n	%	n	%	n	%	n	%
Live alone (widowhood)	1,991	6.5	1	0.0	8	0.2	109	1.4	719	10.2	1,154	46.2
Live alone (never married)	4,988	21.3	3,105	59.3	732	15.9	705	11.1	340	5.4	106	3.9
Parental status												
Yes	24,662	67.9	568	9.9	5,343	77.1	8,201	85.7	7,965	90.6	2,585	90.2
No	7,755	32.1	4,613	90.1	1,140	22.9	1,041	14.3	698	9.4	263	9.8
Housing status												
Tenant	7,934	67.3	2,840	61.9	1,383	27.0	1,412	20.9	1,406	20.1	893	36.9
Owner	24,479	32.8	2,329	38.1	5,110	73.0	7,852	79.1	7,212	79.9	1,976	63.1
Urbanisation												
City	21,572	73.1	3,958	80.8	4,399	73.0	5,834	69.2	5,497	69.8	1,884	71.9
Village/country	10,897	26.9	1,260	19.2	2,111	27.0	3,446	30.8	3,116	30.2	964	28.1
Residential area												
Not deprived	31,354	92.0	4,767	88.2	6,196	91.9	8,978	93.4	8,482	93.8	2,931	93.3
Deprived	1,931	8.1	557	11.8	394	8.1	432	6.6	392	6.2	156	6.7
Greater number of contacts with general practitioner												
Yes	3,116	9.1	224	3.8	325	5.3	638	7.3	1,057	12.9	872	29.4
No	30,169	90.9	5,100	96.2	6,265	94.7	8,772	92.7	7,817	87.1	2,215	70.6
Life-threatening somatic conditions												
Yes	2,797	7.7	59	1.2	99	1.7	615	7.2	1,276	15.3	748	25.3
No	29,880	92.3	5,131	98.8	6,406	98.3	8,661	92.8	7,461	84.7	2,221	74.7
Hospital admissions (somatic department)												
Yes	3,530	10.1	374	6.6	590	8.7	760	8.3	1,164	13.1	642	20.9
No	29,755	89.9	4,950	93.4	6,000	91.3	8,650	91.7	7,710	86.9	2,445	79.1
Prolonged mental disorder												
Yes	1,532	5.5	309	6.2	369	6.4	511	6.6	269	3.6	74	2.8
No	31,145	94.5	4,881	93.9	6,136	93.6	8,765	93.4	8,468	96.4	2,895	97.2
Psychiatric treatment												
Yes	420	1.6	117	2.2	121	2.3	95	1.4	45	0.6	42	1.5
No	32,865	98.4	5,207	97.8	6,469	97.7	9,315	98.6	8,829	99.4	3,045	98.5

[a] All percentages are weighted based on register data to represent the population of the Central Denmark Region, 2013.

"Where are all the lonely people?"

**Table 2. Odds ratio of being moderately or severely lonely in relation to
different socio-demographic and health-related factors.
Multinomial logistic regression analysis, 16+ years**

	Moderate loneliness		Severe loneliness	
	OR	AOR[a]	OR	AOR[a]
Age	0.99*	0.99*	0.99*	1.00
Sex				
Men (ref.)	1	1	1	1
Women	1.28*	1.23*	1.25*	1.21*
Ethnicity				
Danish (ref)	1	1	1	1
Other Western countries	2.26*	2.10*	4.31*	4.46*
Non-Western countries	2.88*	2.29*	4.87*	3.03*
Educational level				
Low	1.24*	1.06	2.16*	1.37*
Medium	1.02	1.07	1.26*	1.34*
High (ref.)	1	1	1	1
Employment status				
Working (ref.)	1	1	1	1
Enrolled in education	1.89*	1.10	2.66*	1.33*
Unemployed	2.81*	1.81*	6.93*	3.23*
Disability pensions	3.35*	1.94*	10.22*	3.30*
Retirement	0.90*	0.87	1.15	0.86
Cohabitation status				
Live with partner (ref.)	1	1	1	1
Live alone (divorced)	2.13*	1.90*	3.87*	2.72*
Live alone (widowhood)	1.63*	2.04*	2.32*	2.97*
Live alone (never married)	2.52*	1.86*	3.57*	2.32*
Parental status				
Yes (ref)	1	1	1	1
No	1.86*	1.12	2.15*	1.17

"Where are all the lonely people?"

Housing status				
Tenant	2.14*	1.28*	3.74*	1.67*
Owner (ref.)	1	1	1	1
Urbanisation				
City	1	1	1	1
Village/country	0.91*	1.13*	0.9	1.42*
Residential area				
Not deprived (ref.)	1	1	1	1
Deprived	1.71*	1.18*	2.89*	1.63*
Greater number of contacts with general practitioner				
Yes	1.52*	1.35*	1.95*	1.23
No	1	1	1	1
Life-threatening somatic conditions				
Yes	1.41*	1.48*	2.16*	1.81*
No	1	1	1	1
Hospital admissions (somatic department)				
Yes	1.16*	0.99	1.75*	1.22
No	1	1	1	1
Prolonged mental disorder				
Yes	3.77*	2.43*	10.18*	4.89*
No	1	1	1	1
Psychiatric treatment				
Yes	3.59*	1.51*	10.61*	2.14*
No	1	1	1	1

[a] Each variable is adjusted for all the remaining variables in the table.
Reference category: non-lonely.

OR=Odds ratio; AOR=adjusted odds ratio
* $p < .05$

"Where are all the lonely people?"

Table 3. Odds ratio of being severe lonely in relation to different socio-demographic and health-related factors in different age groups. Binary logistic regression analysis

	Adolescence/ emerging adulthood 16-29 years (n = 5,176)		Early adulthood 30-44 years (n = 6,421)		Middle adulthood 45-59 years (n = 9,080)		Young-old age 60-75 years (n = 8,320)		Middle old/ old-old age 75+ years (n = 2,544)	
	OR	**AOR[a]**	**OR**	**AOR[a]**	**OR**	**AOR[a]**	**OR**	**AOR[a]**	**OR**	**AOR[a]**
Age	1.01	1.04	0.98	1.01	1.01	1.00	0.96	1.01	1.08*	1.06*
Sex										
Men (ref.)	1	1	1	1	1	1	1	1	1	1
Women	1.60*	1.47*	1.00	1.04	1.02	0.93	1.07	1.00	1.41	1.14
Ethnicity										
Danish (ref)	1	1	1	1	1	1	1	1		
Other Western countries	2.73*	3.78*	4.05*	3.84*	3.38*	3.32*	5.27*	5.41*		
Non-Western countries	1.53	1.26	5.00*	2.86*	5.11*	3.29*	—	—		
Educational level										
Low	2.43*	2.38*	3.69*	1.18	2.29*	0.80	1.69*	1.23	2.39*	1.53
Medium	1.60*	2.31*	1.21	1.09	1.10	0.91	1.21	1.00	1.46	1.29
High (ref.)	1	1	1	1	1	1	1	1	1	1

"Where are all the lonely people?"

Employment status										
Working (ref.)	1	1	1	1	1	1	1	1		
Enrolled in education	1.30	1.50	2.10*	1.24	2.57*	1.30	—	—		
Unemployed	3.51*	2.02*	6.64*	3.29*	5.92*	2.54*	4.17*	4.23*		
Disability pensions	—	—	10.29*	2.82*	10.05*	3.07*	10.30*	6.80*		
Retirement	—	—	—	—	—	—	1.69	1.60		
Cohabitation status										
Live with partner (ref.)	1	1	1	1	1	1	1	1	1	1
Live alone (divorced)	—	—	5.41*	3.21*	3.29*	2.14*	5.03*	3.09*	2.51	2.44
Live alone (widowhood)	—	—	—	—	5.86*	4.51*	3.59*	3.49*	2.35*	1.48
Live alone (never married)	1.32	1.49*	3.94*	2.40*	4.53*	2.84*	4.48*	2.54*	2.53	2.91
Parental status										
Yes (ref.)	1	1	1	1	1	1	1	1	1	1
No	0.70	0.66	2.40*	1.13	2.28*	1.18	2.08*	1.76	1.32	0.63
Housing status										
Tenant	1.28	1.17	5.24*	1.97*	5.36*	1.64*	3.48*	1.68*	1.82*	1.22
Owner (ref.)	1	1	1	1	1	1	1	1	1	1
Urbanisation										
City	1	1	1	1	1	1	1	1	1	1
Village/country	1.00	1.15	0.87	1.43	0.76	1.29	1.30	1.83*	1.49	1.67

Residential area

"Where are all the lonely people?"

Not deprived (ref.)	1	1	1	1	1	1	1	1	1	1
Deprived	2.08*	2.04*	3.41*	1.44	2.95*	1.47	2.09*	1.04	0.64	0.71
Greater number of contacts with general practitioner										
Yes	2.16*	1.09	2.53*	1.10	2.18*	0.77	1.84*	1.35	1.91*	1.61
No	1	1	1	1	1	1	1	1	1	1
Life-threatening somatic conditions										
Yes					4.51*	2.15*	1.84*	1.22	1.83*	1.64
No					1	1	1	1	1	1
Hospital admissions (somatic department)										
Yes	1.67*	1.44	1.38*	0.98	1.53*	1.62*	1.17	0.80	1.24	1.02
No	1	1	1	1	1	1	1	1	1	1
Prolonged mental disorder										
Yes	6.23*	4.74*	6.74*	3.41*	7.69*	2.98*	8.55*	4.39*		
No	1	1	1	1	1	1	1	1		
Psychiatric treatment										
Yes	6.30*	1.63	6.01*	1.31						

"Where are all the lonely people?"

No	1	1	1	1

[a] Each variable is adjusted for all the all remaining variables in the table

Empty cells: figures left out due to few cases (< 100)

OR = Odds ratio; AOR = Adjusted odds ratio;

* $p < .05$

"Where are all the lonely people?"

Fig. 1 Prevalence (%) of moderate and severe loneliness across the life span