



## Research Paper

## Depressive symptoms in the general population: The 7th Tromsø Study

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## ABSTRACT

**Background:** The prevalence of depressive symptoms may differ in various age groups. The aim of the study was to investigate the point-prevalence of depressive symptoms in the adult general population and in various age groups. The impact of sex, marital status, education, and social support on depressive symptoms was also explored.

**Methods:** The population  $\geq 40$  years in the city of Tromsø, Norway, were invited to participate in the survey, of whom 64.7% ( $n=21,083$ ) participated. All participants with a completed Hospital Anxiety and Depression Scale (HADS) were included in the study. A score  $\geq 8$  in the HADS depression subscale (HADS-D) was used to indicate caseness for depression.

**Results:** The caseness for depression was 7.5% for men and 6.3% for women, overall 6.9%. The age groups 40-49 years and 80+ years had highest caseness. The overall HADS-D score for the total population was 2.8 (SD 2.7). The mean HADS-D for men (3.1; SD 2.8) was higher than for women (2.6; SD 2.6) ( $p < 0.001$ ). Low social support, low education and not living with a spouse was associated with higher risk for depressive symptoms.

**Limitations:** The prevalence of depressive symptoms was based on a questionnaire, and represents only an estimate of depression in the population. Participants over 80 years were underrepresented, as fragile elderly and elderly living in nursing homes did not participate.

**Conclusions:** Depressive symptoms were more prevalent in the youngest and oldest age groups. Participants reporting low social support, low education and not living with a spouse had higher risk for depressive symptoms.

## 1. Introduction

Depression is a common disorder and has been ranked as the second largest contributor to global disability (Vos et al., 2012). Typical symptoms are sadness, loss of interest or pleasure, tiredness and lack of energy, poor concentration, disturbed sleep or appetite and low self-confidence. Some studies on the prevalence of depression have reported 12-month prevalence as low as 2.2% for depression in Japan, 4.9% in the Netherlands, but with higher figures of 10.4% in Brazil and 13.5% in the US (Bromet et al., 2011). A study of a randomly selected Norwegian urban population used clinical interviews and reported a 7.3% 12-month prevalence of depression (Kringlen et al., 2001). A meta-analysis of 90 studies from 30 countries reported a median point prevalence of 12.9% for depression, but with a large heterogeneity in prevalence across studies (Lim et al., 2018). These differences may have several explanations such as measurement methods, definition of the

disorder and actual variations in prevalence between countries. Also, there have been reports of an increase in depressive symptoms over the last decades. Lim et al. (2018) reported an aggregate prevalence of 9.8% for studies published from 1994 to 2003 and 15.4% for studies published from 2004 to 2014. The same tendency was reported in the US population from 2005 to 2015 (Weinberger et al., 2018). Therefore, it may be important to continually present updated data on the prevalence of depression in different areas and populations.

Most studies have found a higher prevalence of depression in women than in men (Kuehner, 2017; Salk et al., 2017; Van de Velde et al., 2010). However, in a large population survey using the Hospital Anxiety and Depression Scale (HADS), only minor sex differences were reported (Stordal et al., 2001). A similar trend was observed in another population survey using HADS (Djukanovic et al., 2015).

Epidemiological studies using structured interviews and standard diagnostic criteria for depression have reported a decreasing prevalence

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with age (Kessler et al., 2010b; Scott et al., 2008). Studies using symptom scales find, however, a less clear association; some show decreasing depression scores with age (Henderson et al., 1998), while others report the opposite (Solhaug et al., 2012; Stordal et al., 2001). People born in the 1940s and -50s, the so-called baby boomers, are becoming older, and it is of great interest and importance to investigate the magnitude of depressive symptoms in different age groups of this new cohort of elderly.

Social support is regarded as one of the social determinants of health in the general population, and low social support can increase the risk of depression (Allen et al., 2014; Grav et al., 2012; Marmot et al., 2012; Tengku Mohd et al., 2019). Furthermore, educational level is regarded as an indication of socio-economic status (Krieger et al., 1997). The role of education has been investigated in several studies, and a low level of education seems to increase the risk of depression (Chang-Quan et al., 2010; de Graaf et al., 2012; Peyrot et al., 2015).

The aim of this cross-sectional study was to examine the point-prevalence of depressive symptoms and the association between age and depressive symptoms in an adult population ( $\geq 40$  years old) in the city of Tromsø in Norway, using the HADS subscale for depression (HADS-D). Furthermore, we explored depressive symptoms in relation to sex, education, marital status, and social support.

## 2. Methods

### 2.1. Study population

The 7th Tromsø Study (Tromsø 7) from 2015 to 2016 is the most recent wave in a series of population-based cohort surveys in the municipality of Tromsø in northern Norway. All inhabitants  $\geq 40$  years living in Tromsø ( $n = 32,591$ ) were invited to participate, of whom 21,083 (64.7%) participated. The survey includes self-administered questionnaires on health status, socioeconomic factors, lifestyle, potential risk factors, clinical examination, interviews and biological sampling. The 7th wave also includes mental health symptoms measured by the HADS. All participants with completed HADS questionnaires were included in the present study.

### 2.2. Hospital Anxiety and Depression Scale

The HADS is a self-administered scale consisting of 14 items. The participants were asked to report the feelings they had experienced during the last week. The score consists of two seven-item subscales for depression (HADS-D) and anxiety (HADS-A), each item has a four-point scale to describe symptom severity. The HADS was originally developed to identify the prevalence of anxiety disorder and depressive disorder among patients in non-psychiatric hospital clinics (Zigmond and Snaith, 1983). Thus, symptoms of anxiety and depression that are also related to physical disorders, such as dizziness, insomnia and fatigue, were excluded. The psychometric properties of the Norwegian version of the HADS have been found to be satisfactory (Mykletun et al., 2001).

A meta-analysis of validation studies reported an optimal balance between specificity and sensitivity with a HADS-D cut off  $\geq 8$  giving a sensitivity and specificity for a diagnosis of depression of approximately 0.8 (Bjelland et al., 2002). Persons with HADS-D  $\geq 8$  have considerable depressive symptoms, even if not all will fulfill criteria for a diagnosis of depression according to the DSM-V or ICD-10 criteria. In the present study, a cut off  $\geq 8$  was used to identify participants with possible depression (caseness). A score between 8 and 10 indicates mild symptoms, 11–14 indicates moderate symptoms and  $\geq 15$  indicates severe symptoms according to the original norms (Zigmond and Snaith, 1983).

All HADS-D questionnaires with more than two out of seven missing items were excluded. Questionnaires with five or six items were thus included in the study, and the scores used in the analyses were based on the sum of completed items, multiplied by 7/5 or 7/6, respectively.

### 2.3. Covariates

Age was measured both as a continuous and a grouped (10-year groups) variable. Education was measured by asking about the highest level of education completed ( $\leq 10$ , 11–13, 14–16 and  $> 16$  years). Marital status was based on whether the participant was living with a spouse/partner or not. In Tromsø 7, perceived social support was measured as tangible and emotional support, with one single item each. Tangible support was based on the question 'Do you have enough friends who can give you help and support when you need it?' For emotional support, the participants were asked 'Do you have enough friends you can talk confidentially with?'. For both questions, the categorical response choices were either 'yes' or 'no'.

### 2.4. Statistics

Internal consistency for the HADS-D was assessed using Cronbach's alpha. Frequencies were used to describe the population characteristics. Chi-square tests were used to explore differences in caseness within variable groups (sex, age, education etc.) To analyze the impact of sex and age and the interaction between them on the level of depressive symptoms, a two-way between-group analysis of variance (ANOVA) was conducted. A Tukey HSD test was used to perform a post hoc comparison of mean HADS-D between different age groups. Furthermore, a logistic regression model was used with HADS-D scores in two categories: less than 8.0 vs. 8.0 and above, as a dependent variable to further assess the impact of age, sex and possible risk factors. All statistical analyses were performed with SPSS version 26 software (SPSS Inc., Chicago, IL).

### 2.5. Ethics

All participants gave written consent to the scientific use of the health survey data. The Tromsø Study has a license from the Norwegian Data Inspectorate and has been approved by the Regional Committee for Medical and Health Research Ethics. The present study is part of a research project approved by the Regional Ethical Committee North (ref. 150,757). The study complies with the Declaration of Helsinki.

## 3. Results

In Tromsø 7, 10,009 (62.4%) of invited men and 11,074 (67.5%) of women participated. The number of invited individuals in each age group, the number of participants and the number of individuals with valid HADS-D scores are presented in Table 1. Missing data for HADS-D score was 2.3%, for education 1.8%, for tangible support 12.4% and for emotional support 15.5%. The mean age of the participants was 57.2 years for men and 57.4 years for women. Other characteristics of the population are presented in Table 2. The internal consistency of the HADS-D measured by Cronbach's alpha was 0.72 (men 0.70, women 0.74).

A HADS-D score  $\geq 8$  was used to indicate caseness, meaning the presence of clinically significant depressive symptoms. The caseness for men and women were 7.5% and 6.3%, and the overall caseness in the population was 6.9%. The overall mean HADS-D score in the study population was 2.8 (SD 2.7). The mean score in the male population was 3.1 (SD 2.8), and in the female population 2.6 (SD 2.6) ( $p < 0.001$ ). Participants over 80 years old had a higher mean score (3.4) and caseness (8.9%) than other age groups. Participants who were living without a partner, had a low level of education, and who experienced low tangible and emotional support had higher HADS-D scores. A more detailed overview of mean HADS-D and caseness is presented in Table 3.

Two-way between-group analysis of variance (ANOVA) was conducted to explore the impact of sex and age on the levels of depressive symptoms, as measured by the HADS-D. There was a significant main effect for age,  $F = 11.89$ ,  $p < 0.001$ ; however, the effect size was very small (partial eta square = 0.002). The interaction effect between sex

**Table 1**  
Numbers of individuals invited to participate in the Tromsø 7 Study by age and sex.

Age group (years)	Men			Women		
	Number invited N	Number participated N	Valid HADS score N (%)	Number invited N	Number participated N	Valid HADS score N (%)
40–49	5562	3054	2992 (53.3)	5195	3378	3322 (63.9)
50–59	4327	2790	2735 (63.2)	4534	3245	3179 (70.1)
60–69	3543	2502	2459 (69.4)	3586	2677	2634 (73.5)
70–79	1897	1315	1282 (67.5)	2001	1361	1306 (65.3)
80+	723	348	319 (44.1)	1223	413	366 (29.9)

**Table 2**  
Demographic and other characteristics of the study population.

		Total	Men	Women
Age (years)	Mean (SD)	57.3 (11.4)	57.2 (11.4)	57.4 (11.4)
Living with a partner	N (%)	15,283 (77)	7880 (81.6)	7403 (72.3) *
Level of education				
≤10 years	N (%)	4796 (23)	2179 (22.2)	2617 (24.1)
11–13 years	N (%)	5756 (28)	2997 (30.5)	2759 (25.4) *
14–16 years	N (%)	4008 (19)	2091 (21.3)	1917 (17.6)
≥ 16 years	N (%)	6145 (30)	2564 (26.1)	3581 (32.9) *
Tangible social support	N (%)	18,460 (89)	8764 (89.0)	9696 (89.6)
Emotional social support	N (%)	17,813 (86)	8113 (82.7)	9700 (89.4) *

\* Significant difference using the chi-square test ( $p < 0.001$ ).

**Table 3**  
HADS-D mean score and relation between caseness (HADS-D ≥ 8) and background variables.

Variables	HADS-D mean (SD)	HADS-D ≥8% (n)	$\chi^2$	$P^*$
Sex				
Men	3.1 (2.8)	7,5 (740)		
Women	2.6 (2.6)	6.3 (681)	10.662*	<0.001
Age groups (year)				
40–49	2.9 (2.9)	8.0 (502)		
50–59	2.8 (2.8)	6.8 (405)		
60–69	2.7 (2.6)	5.7 (292)		
70–79	3.0 (2.6)	5.8 (151)		
80+	3.4 (2.8)	8.9 (61)	30.414*	<0.001
Living with a partner				
yes	2.7 (2.6)	5.9 (886)		
no	3.2 (3.0)	9.2 (413)	61.628*	<0.001
Level of education (year)				
≤10	3.1 (2.8)	8.2 (379)		
11–13	2.8 (2.7)	7.0 (393)		
14–16	2.8 (2.7)	6.5 (257)		
≥16	2.6 (2.7)	5.9 (356)	23.998*	0.001
Tangible support				
yes	2.6 (2.5)	5.0 (900)		
no	4.9 (3.5)	22.4 (478)	910.148 *	<0.001
Emotional support				
yes	2.5 (2.5)	4.7 (825)		
no	4.7 (3.4)	20.1 (553)	882.163 *	<0.001

\* Chi-square test based on caseness (HADS-D ≥8).

and age group was not significant,  $F = 0.17$ ,  $p = 0.95$ . A post hoc comparison using the Tukey HSD test indicated that the mean HADS-D score of the 80+ year age group was significantly higher than those of the other age groups. The age groups 50–59 years and 60–69 years had

significantly lower HADS-D scores (2.77; SD=2.77 and 2.73; SD=2.60) than the age groups 70–79 years and 80+ years (2.99; SD=2.57 and 3.39; SD=2.83).

The prevalence of mild, moderate and severe symptoms among men was 5.7%, 1.6% and 0.2%, respectively. For women, the prevalence was 4.7%, 1.4% and 0.1%, respectively.

Logistic regression was performed to assess the impact of different potential risk factors. In model 1, age, sex and living with a spouse or partner were included. In model 2, education and social support were added to the first model. As shown in Table 4, model 2 explained between 4.0% and 10.4% of the variance in HADS-D status. The risk for depression was significantly lower in the age group 50–79 years, compared to the age group 40–49. Social support, living with a spouse or partner and education made the largest contributions to the model. The sex difference was not significant after adding education and social support to the model.

#### 4. Discussion

In this general population study, we found a mean score on the HADS-D to be 2.8. A score indicating caseness for depression was reported by 6.9% of the participants. Caseness was more frequent in the youngest (40–49 years of age) and the oldest (80+) age groups. There was higher depression caseness reported in men than in women, but this difference disappeared when adjusting for other variables. Low social support, low education and not living with a spouse were factors associated with higher risk for depressive symptoms.

**Table 4**  
Results from logistic regression with HADS-D (≥ 8) as the dependent variable.

Variables	unadjusted	Model 1 OR (95% CI)	Model 2 OR (95% CI)
Age group			
40–49	1.00 (ref)	1.00 (ref)	1.00 (ref)
50–59	0.88 (0.67–1.17)	0.85 (0.74–0.98)	0.81 (0.70–0.94)
60–69	0.75 (0.57–1.00)	0.68 (0.58–0.80)	0.67 (0.56–0.79)
70–79	0.62 (0.47–0.83)	0.69 (0.57–0.84)	0.57 (0.46–0.71)
80+	0.63 (0.47–0.86)	0.98 (0.72–1.33)	0.74 (0.52–1.05)
Sex			
men	1.00 (ref)	1.00 (ref)	1.00 (ref)
women	0.84 (0.75–0.93)	0.81 (0.72–0.90)	0.91 (0.81–1.03)
Living with a partner			
yes	1.00 (ref)	1.00 (ref)	1.00 (ref)
no	1.62 (1.44–1.83)	1.70 (1.50–1.92)	1.55 (1.36–1.77)
Education			
≤10 y	1.44 (1.24–1.67)		1.51 (1.27–1.80)
11–13 y	1.20 (1.04–1.36)		1.19 (1.02–1.4)
14–16 y	1.12 (0.95–1.32)		1.14 (0.95–1.05)
>16 y	1.00 (ref)		1.00 (ref)
Social support			
Tangible			
yes	1.00 (ref)		1.00 (ref)
no	5.5 (4.87–6.21)		2.46 (2.06–2.94)
Emotional			
yes	1.00 (ref)		1.00 (ref)
no	5.06 (4.51–5.70)		2.85 (2.41–3.34)

Model 1: Cox & Snell R square= 0.005; Nagelkerke R square= 0.013.  
Model 2: Cox & Snell R square= 0.040; Nagelkerke R square=0.104.

Both the mean HADS-D scores for men and women and caseness for depression were lower than those reported in several other population studies using HADS. In a Swedish study of an elderly (65–80 years), randomly selected population, 9.8% of the participants had a HADS-D score  $\geq 8$  (Djukanovic et al., 2015). Breeman et al. found in a population study from Northwest England a prevalence of depression (HADS $\geq 8$ ) of 17.3% for both men and women in the age group 40–65 years. In a study on a randomly selected German population, a mean HADS-D score of 4.8 for men and 4.7 for women were reported (Hinz and Brahler, 2011). In another Norwegian population study, HUNT 2 (1995–97), a mean score of 3.6 for men and 3.4 for women was reported compared to 3.1 and 2.6 in our study (Stordal et al., 2001). Tromsø 7 was conducted on an urban population in 2015–16, compared to the mentioned studies conducted either in rural or mixed (both urban and rural) populations. Studies on differences in prevalence of depression in rural vs urban populations are however inconsistent (Probst et al., 2006; Purtle et al., 2019; Steffen et al., 2020; Wang, 2004). A lower prevalence in our study could be caused by a cohort effect, but due to large variations between countries we should be careful to draw such a conclusion. However, some previous studies have even reported an increase in the prevalence of depression in the last 10–20 years (Lim et al., 2018; Weinberger et al., 2018), but our study does not seem to support this. The data from our study was collected in 2015–2016. Meanwhile, the Covid-19 pandemic could have affected the current prevalence for depression in the population (Bauerle et al., 2020).

For both sexes, there is a slightly lower prevalence of depressive symptoms in the age group 50–80 years than in the age groups 40–50 years and 80 years and above. Several other surveys report a lower prevalence of clinical depression in elderly people than in younger people (Jorm, 2000; Kessler et al., 2010a; Patten et al., 2015), but few have analyzed differentiated age classes among the elderly. The HUNT 2 study shows, however, an increasing prevalence of depressive symptoms with increasing age from 20–29 years to 80–89 years (Stordal et al., 2001).

A higher prevalence of depressive symptoms among participants 80 years or older may be explained by very old people being more likely to have some well-known risk factors for depression, such as chronic medical illnesses, loneliness, and losses. The higher prevalence in the 40–49-year group is, however, more difficult to explain. In our study, the participants in the age group (40–49 years) generally had higher education, more often lived with a partner, and described better social support than older participants. However, in the logistic regression model, the risk for depression in the youngest age group compared to older age groups (up to 80+) even increased when controlling for education and social support. This indicates that low education and low social support to a greater extent was associated with depressive symptoms in the youngest age group. We even found a higher risk for depression for participants that did not live with children in this age group (data not shown). It might be that persons in the younger age group (40–49 years) experience a life situation with low education, no children and low level of social support as more different from their peers and, perhaps more stigmatizing, than in the older age group. Studies on age and happiness and stress have found an almost universally present U-shaped relationship between age and happiness, with the lowest levels of happiness and the highest levels of stress in middle-age (Blanchflower and Oswald, 2008). Our data suggest, however, that it is not middle-aged people living a stressful life pursuing careers and parenthood that are most at risk for depression, but rather middle-aged people whose life situation is experienced as being more in contrast to others in the same age group. Another speculation is that low social support and not living with children might in fact be a proxy for life crisis or losses that are not registered in the study.

We found a trend towards a higher prevalence of clinically significant depressive symptoms in the male population, however in the logistic regression analysis, sex difference was not significant when education and social support were added to the model. A slightly higher

prevalence of depression in men was also reported in other studies using HADS (Djukanovic et al., 2015; Stordal et al., 2001). A large number of studies, however, have confirmed an overrepresentation of women in terms of both major depression and depressive symptoms (Salk et al., 2017). This overrepresentation of women has been reported in studies based on structured interviews and standard diagnostic criteria and in most symptom scale-based studies (Faravelli et al., 2013; Van de Velde et al., 2010). The HADS-D includes questions about depressed mood and loss of interest or pleasure, which cover two of the three basic criteria for depression according to the ICD-10. Lack of energy and increased tiredness are not covered, nor are questions about sleep and appetite. These symptoms are often referred to as somatic symptoms. Silverstein et al. (2013) found that the sex difference disappears when these symptoms are not included (Silverstein, 1999). This could be one explanation for our findings relating to sex differences, in addition to education and social support.

In the logistic regression analysis, social support made the largest contribution to the model. The risk for depressive symptoms were high for participants with both low tangible and emotional support. A slightly higher proportion of women reported good emotional support, which is in line with a common conception of sex differences in this field, i.e. that women tend to have better social support networks than men. This difference was significant in all age groups, except for the 80+ age group (data not shown). In our study, a chi-squared test revealed a significantly higher prevalence of depression among persons who reported both low emotional support and low tangible social support. The effect of social support as a protection against depression has been reported in several studies. A meta-analysis of 36 studies on social support reported a significant association between social support and protection from depression among adults in 89% of studies, and almost the same result was found among older adults (Garipey et al., 2016). The same study reported that support from a spouse was most important. In our study, participants aged 40–69 years living without a spouse had a significantly higher prevalence of depression than participants living with a spouse, but for people aged 70 years and older, there was no significant difference (data not shown).

A low level of education has been reported to increase the risk for depression in several population studies (Bjelland et al., 2008; Brunoni et al., 2020; Park et al., 2012), but others have found an opposite result (Akhtar-Danesh and Landeen, 2007). In our study we found an especially high risk for depression for participants with only primary school compared to those with the highest education level.

#### 4.1. Strengths and limitations

This study has some limitations. We did not have data on current treatment for depression. Furthermore, information about chronic medical illnesses, known to be associated with depression (Vu et al., 2018; Zhang et al., 2011), was not available. Other possible confounders, such as income and alcohol use, were not included in the study. The point prevalence of depressive symptoms was based on a self-report questionnaire, which has its limitations due risk of recall bias and subjectivity. The gold standard for establishing psychiatric diagnosis involves structured clinical interview, and the prevalence numbers in the study thus represent only an estimate of depression in the population. The sample sizes in the oldest age groups (70–79 years and 80+) are small compared to other age groups, which could lead to more unreliable results. Our data have not been weighted against age and gender differences between participants and the population in Norway.

On the other hand, the survey is one of the largest population surveys in Norway, with a high completion rate, using a validated instrument for depressive symptoms. Participants 80 years and older had a considerably lower completion rate, which could be because a higher proportion in this age group either live in a nursing home or are too fragile to participate in this kind of survey, which also required in-person attendance for testing. Previous studies have demonstrated that non-

participants in population surveys tend to have more psychiatric symptoms than participants (Hansen et al., 2001). Thus, the point prevalence found in the study is most likely an underestimate of the true value in the population.

## 5. Conclusion

In this study on an adult population ( $\geq 40$  years), we found the highest point-prevalence of depressive symptoms in the age groups 40–49 years and 80+ years. The caseness for depression using HADS-D $\geq 8$  was higher for men than for women, but the difference disappeared after controlling for other factors such as education and social support. Participants reporting low social support, low level of education and living without a spouse had increased risk for depressive symptoms.

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## Author statement

The authors certify that they have participated sufficiently in the work of this study. All authors contributed to the design of the study. OG performed the statistical analysis and made the first draft of the manuscript. JB, AH and RW provided feedback on the drafts of the manuscript and all authors approved the final manuscript.

## CRediT authorship contribution statement

**Ole Kristian Grønli:** Visualization, Formal analysis, Writing – original draft, Writing – review & editing. **Jørgen G. Bramness:** Visualization, Writing – review & editing. **Rolf Wynn:** Visualization, Writing – review & editing. **Anne Høye:** Visualization, Writing – review & editing.

## Declaration of Competing Interest

None

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