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Secular trends in the prevalence of dementia and depression in Swedish septuagenarians 1976-2006

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ABSTRACT

Background: It is not clear whether the prevalence of dementia and depression among the elderly has changed during the last 30 years.

Methods: Population-based samples from Gothenburg, Sweden were examined with identical psychiatric and neuropsychiatric examinations at age 70 in 1976-77 (N=404; response rate 78.8%) and 2000-01 (N=579 individuals; response rate 66.4 %), and at age 75 in 1976-77 (N=303; response rate 78%) and 2005-06 (N=753; response rate 63.4%). Depression was diagnosed according to DSM-IV and dementia according to Kay's criteria.

General Linear Models were used to test differences between groups.

Results: Dementia was related to age, but not to birth cohort or sex. Major depression was related to sex (higher in women), but not to birth cohort or age. Minor depression was related to birth cohort, sex (higher in women), age (higher at age 75), and the interaction effect of birth cohort*age, i.e. the prevalence of minor depression increased with age in the 2000s, but not in the 1970s. Thus, the prevalence of minor depression was higher in 2005/06 compared to 1976/77 among 75-year-olds both among men (12.4% versus 3.7%) and women (19.1% versus 5.6%), while there were no birth cohort differences at age 70.

Conclusion: Secular changes were only observed for minor depression, which is considered to be more related to psychosocial factors than major depression. The high prevalence of minor depression in later-born birth cohorts emphasizes the importance to detect minor depression in the elderly.

INTRODUCTION

The numbers and proportions of elderly people are increasing in most countries in the world. Depression and dementia are among the most common causes of disability and reduced life satisfaction in the elderly (Skoog, 2008).

Large changes occurred during the 20th century in areas such as perinatal care, urbanisation and secularisation, education, social circumstances, work related conditions, retirement conditions, housing, hygien, dietary habits, gender roles, health care, survival, and in general health. For example, the prevalence of cardiovascular risk factors in midlife, such as smoking, hypertension, and hypercholesterolemia decreased, while the proportion with overweight and diabetes increased between 1963 and 2003 (Wilhelmsen et al. 2008). We recently reported that 70-year-olds examined 2000-01 had better cognitive function (Sacuiu et al. 2010), higher educational level (Beckman et al. 2008), were healthier (Wilhelmson et al. 2002), more often happily married (Beckman et al. 2008), and more sexually active (Beckman et al. 2008) than 70-year-olds examined 1971-72. Many factors related to dementia (Skoog, 2008) and depression (Palsson and Skoog, 1997) in the elderly have thus changed dramatically in frequency during the last decades. It is not clear whether this has changed the frequency of the disorders. A study from Zaragoza, Spain, reported that the prevalence of dementia decreased in men but not in women between 1988-89 and 1994-96 (Lobo et al. 2007), while a study from Indianapolis reported no change in the prevalence of dementia from 1992 to 2001 (Hall et al. 2009).

It has been suggested that the frequency of depression has increased (Klerman and Weissman, 1989; Kessler et al. 1994; Kasen et al. 2003; Compton et al. 2006), and age of onset decreased (Klerman and Weissman, 1989; Kasen et al. 2003) in later-born birth cohorts during the 20th century, while others report no consistent trend in depression prevalence between birth

cohorts born between 1929 and 1991 (Spiers et al. 2012). However, changes reported may be influenced by changes in diagnostic criteria, level of care of psychiatric patients, and participants´ willingness to admit psychiatric symptoms. Epidemiological studies using similar methods in different birth cohorts to study secular trends in the frequency of psychiatric disorders are rare, not at least in the elderly.

The aim of this study was to examine secular trends in the prevalence of dementia and depression among samples representative of the general population of 70- and 75-year-olds from Gothenburg, Sweden, who were examined with identical methods in 1976-77, 20-01 and 2005-06.

METHODS

Samples

The multidisciplinary H70 studies started in the 1970s with the aim to study health and health-related factors in elderly populations from Gothenburg, Sweden. Samples of 70- and 75 year-olds examined within these studies are described below. All samples were systematically obtained, based on birth dates, from the Swedish Population Register, which covers names and addresses of all people living in Sweden. The studies included persons living in private households and in institutions. Data from each examination year are cross-sectional.

70-year-olds

Cohort 1906-07: All 70-year-olds living in Gothenburg and born between July 1, 1906 and June 30, 1907 on dates ending with 2, 5 or 8 were invited to a health examination in 1976-77. All individuals were numbered consecutively from 1 to 5. Those with numbers 1 and 2 (n=513) were invited to take part in a psychiatric examination. Among those, 404 (177 men and 227 women) were examined (response rate 78.8%). The sample has been described in detail previously (Nilsson, 1983).

Cohort 1930: All 70-year-olds living in Gothenburg and born during 1930 on days 3, 6, 12, 18, 21, 24, or 30 of each month, were invited to a health examination in 2000-01 (N=758). Four persons could not be found and seven could not speak Swedish, leaving an effective sample of 747. Among these, 579 individuals (229 men and 350 women) accepted participation in the psychiatric examination (response rate 66.4 %). The sample has been described previously (Beckman et al. 2008).

75-year-olds

Cohort 1901-02: All 75-year-olds living in Gothenburg and born between July 1, 1901 and June 30, 1902 on dates ending with 2, 5 or 8 were invited to a health examination in 1976-77. All individuals were numbered consecutively from 1 to 5. Those with numbers 1 and 2 (n=388) were invited to take part in a psychiatric examination. Among those, 303 (117 men and 186 women) were examined (response rate 78%). The sample has been described in detail previously (Nilsson and Persson, 1984).

Cohort 1930: All 75-year-olds living in Gothenburg and born during 1930 on days 2, 3, 5, 6, 11, 12, 16, 18, 20, 21, 24, 27, or 30 of each month were invited to a health examination in 2005-06 (N=1250). Ten died before they could be examined, two had emigrated outside Sweden, 32 could not speak Swedish and 18 could not be traced, leaving an effective sample of 1188 individuals. Among those, 753 (321 men, 432 women) accepted to take part in the psychiatric examination (response rate 63.4%). Among those, 371 (49.3%) had also taken part in the examination at age 70 years.

Responders and non-responders in each of the samples (1976-77, 2000-01, 2005-06) were similar regarding gender and marital status. In 1976-77, responders and non-responders born 1901-02 and 1906-07 were further compared with regard to income, municipal rent allowance, previous outpatient or in-patient psychiatric care, registration with the Temperance Board for alcohol abuse, and 3-year mortality rate based on information from the Swedish Population Register. There were no significant differences between responders and non-responders regarding these factors (Nilsson, 1983; Nilsson and Persson, 1984; Beckman et al. 2008). Responders and non-responders born 1930 were further compared with regard to in-patient psychiatric care during the past two years according to the Swedish Hospital Discharge Register, and 3-year mortality rate. No differences were found between participants

and non-participants among 70-year-olds in 2000-01 regarding these factors (Beckman et al. 2008). Among 75-year-olds in 2005-2006, non-participants more often died before age 78 compared to participants (14.9% versus 5.2%; Fisher's exact test: $p<0.001$, DF=1). There were no significant differences between the groups regarding the prevalence of psychiatric diagnoses (5.7% versus 4.4%, $p<0.328$, DF=1), depression (3.2% versus 2.0%; Fisher's exact test: $p=0.241$, DF=1), and dementia (4.1% versus 2.7%; Fisher's exact test: $p=0.173$, DF=1) in the Swedish Hospital Discharge register.

After complete description of the study to the subjects, written informed consent was obtained. The study was approved by the Ethics Committee for Medical Research at the University of Gothenburg.

The general examinations included home-visit by a nurse, psychiatric examinations by psychiatrists (psychiatric nurses for those born 1930), physical, neuropsychological, and dental examinations and examinations of social factors, functional ability and somatic disorders. Laboratory tests included ECG and extensive biochemical evaluations.

The psychiatric examination included psychiatric signs and symptoms rated according to the Comprehensive Psychopathological Rating Scale (CPRS) (Asberg et al. 1978) and ratings of cognitive functions, such as memory, language, visuospatial and executive abilities. It was performed by psychiatrists at the examinations in 1976-77, and by experienced psychiatric nurses at the examinations in 2000-01 and in 2005-06. Questions were identical at each examination.

The psychiatric nurses were supervised and trained by a psychiatrist (Ingmar Skoog) who, in his turn, was trained by the psychiatrists who performed the examinations in 1976-77. Before

data collection began, inter-rater reliability was investigated among 50 individuals who had concomitant dual ratings by either psychiatric research nurses or psychiatrists. Kappa values for the presence versus absence of signs and symptoms necessary to diagnose depression were between 0.62 and 1.00 indicating “good” (reference range kappa=0.61-0.80) or “excellent” (kappa=0.81-1.00) agreement. Inter-rater agreement for the signs and symptoms used to diagnose dementia was between 89.4% and 100.0% (kappa values between 0.74 and 1.00) (Wancata et al. 2007).

We were not able to diagnose dementia according to DSM criteria in 1976-77. To make comparisons possible between the birth cohorts, we therefore had to diagnose dementia according to the historical criteria described by Kay et al (Kay et al. 1964), which were widely used in the 1970s. These criteria required the presence of severe disorientation for time or place or severe memory impairment as assessed during the psychiatric examination. In 2000-01, we were able to diagnose dementia according to both the historical and the DSM-III-R criteria (American Psychiatric Association, 1987; Skoog et al. 1993, a). As described previously (Wancata et al. 2007), the observed agreement for a dementia diagnosis between the historical and the DSM-III-R criteria was high (kappa=0.807).

Major depression was diagnosed according to DSM-IV (American Psychiatric Association, 1994) using a symptom algorithm as described previously (Skoog et al. 1993, b). The diagnosis of major depression required the presence of at least 5 out of 9 prespecified symptom clusters, according to DSM-IV. Minor depression was diagnosed according to Criteria Sets and Axes Provided for Further Study in DSM-IV-TR (American Psychiatric Association, 2000). The diagnosis of minor depression required the presence of 2-4 of the same prespecified symptom clusters as in major depression. Thus, major and minor depression were mutually exclusive. The diagnoses were based on symptoms during the month preceding the examination.

Statistical methods

We used a General Linear Model, GEE (generalized estimates equation), in order to account for correlations between repeated assessments on the same individuals in the 1930 cohort at ages 70 and 75. This is a model considered suitable for unbalanced data, to test differences between the groups (Ghisletta and Spini, 2004). The first analysis included all participants, and had dementia as dependent variable, and sex, age and birth cohort as independent variables. The next set of analyses tested interaction effects and had dementia as dependent variable, and sex, age, birth cohort, sex*age (i.e. interaction effect of sex and age), sex*birth cohort, and age*birth cohort as independent variables. The same analytic procedure was repeated for major depression and minor depression. All p-values were two-tailed and p-values <0.05 were considered statistically significant. Non-significant results are not reported in the Results section.

Statistical software used was SPSS for Windows version 18. The GEE models was calculated by procedure GENLIN using the robust estimator of the parameter estimate covariance matrix (COVB=ROBUST).

The Wilson Score method was used to calculate 95% confidence intervals for binomial proportions.

RESULTS

The prevalence of dementia in 70- and 75-year-olds in relation to age, sex and examination year is given in table 1. The prevalence of dementia was 2.0% in 1976-77 and 2.4% in 2000-01 among 70-year-olds, and 5.0% in 1976-77 and 6.0% in 2005-06 among 75-year-olds. The first General Linear Model showed that dementia was related to age ($p<0.001$), but not to birth cohort or sex. The second GLM, showed that there was an interaction effect between sex and age ($p=0.17$), i.e. the prevalence of dementia increased more with age in men than in women in both birth cohorts.

The prevalence of major and minor depression in 70- and 75-year-olds in relation to age, sex and examination year are given in table 2 and table 3. Those with dementia were excluded from the sample in the analyses of the prevalence of depression. The first General Linear Model showed that major depression was related to sex ($p=0.007$), but not to birth cohort or age (table 2). The second GLM analyses showed no interaction effects between sex, age and birth cohorts for major depression. We then repeated the analyses with minor depression as the dependent variable (table 3). The first General Linear Model showed that minor depression was related to birth cohort ($p<0.01$), sex ($p=0.001$), and age ($p=0.026$). The second GLM analyses showed that minor depression was related to birth cohort ($p<0.01$), sex ($p=0.020$), age ($p=0.009$), and the interaction effect of birth cohort*age ($p=0.004$), i.e. the

prevalence of minor depression increased with age in the 2000s, but not in the 1970s and the birth cohort difference was only observed among 75-year-olds.

DISCUSSION

To our knowledge, this is the first study reporting on secular trends in the prevalence of dementia and depression in later life using identical methods in population samples examined over three decades. We found no support for birth cohort differences in the prevalence of dementia at age 70 and 75 years. Similarly, no differences could be shown regarding the prevalence of major depression. The prevalence of minor depression, however, increased with age in the later-born cohort, but not in those examined in the 1970s. Minor depression was thus more prevalent in the later-born cohort among 75-year-olds.

The prevalence of dementia did not change during the 30-year period, despite higher educational level, better results on cognitive tests, better socioeconomic status, better treatment of vascular risk factors and better general physical health in the later-born cohort (Sacuiu et al, 2010; Beckman et al, 2008). Given these large secular changes, a decrease in the prevalence of dementia might have been expected. On the other hand, increased survival might result in more people with risk factors for dementia surviving into old age. Previous studies on secular changes in the prevalence of dementia have examined much shorter time intervals. A recent study from Indianapolis found no difference in the prevalence of dementia between 1992 and 2001 (Hall et al. 2009), while a study from Spain reported a decrease

among men between 1988-89 and 1994-1996 (Lobo et al. 2007). Considering the low prevalence of dementia at age 70 and 75, it is possible that our study did not have the power to detect small changes in the frequency of dementia. However, we note that our prevalence figures for dementia are similar to those reported from other studies in this age group (Lobo et al. 2007; Skoog, 2008; Hall et al. 2009), and in line with the suggestion that the prevalence of dementia doubles for every five year increase in age (Jorm et al. 1987).

Our findings of no change in the prevalence of major depression between birth cohorts should be seen in light of previous birth cohort studies. We could not confirm previous reports from the United States of an increased frequency of major depression during the later part of the 20ths century (Klerman and Weissman, 1989; Compton et al. 2006). It has been suggested that people born in the early part of the last century had lower rates of major depression than those born after World War II (Klerman et al. 1985; Lavori et al. 1987 Wickramaratne et al. 1989; Weissman et al. 1992). As both our cohorts were born before World War II, we cannot comment on this hypothesis. Our findings are also in line with older and more recent studies in the elderly reporting that the prevalence of major depression do not increase with age (Steffens et al. 2000; Eaton et al. 2007; McDougall et al. 2007; Byers et al. 2010, Spiers et al. 2012)

We found that the prevalence of minor depression increased substantially among 75-year-old men and women from 1976-77 to 2005-06. The very high prevalence of minor depression among 75-year-olds in 2005-06 may seem somewhat surprising. This finding is similar to a study from Indianapolis where the prevalence of overall depression in the elderly increased between 1992 and 2001 (Hall et al. 2009), and another Swedish study reporting that the prevalence of milder forms of depression increased during the 20ths century (Hagnell et al.

1982). Minor depression is suggested to be more closely related to psychosocial factors, while major depression is thought to be more biologically and genetically determined (Beekman et al. 1995). Socioeconomic context may thus be more important for minor than for major depression. The finding that the prevalence of minor depression increased in 75-year-olds may be related to both period effects, i.e. factors occurring around 2005-06, or birth cohort effects, i.e. factors occurring during the life span of the two birth cohorts. We are not aware of any period effects potentially related to the prevalence of mild depression occurring around 2005-06. However, as mentioned above, large secular changes in socioeconomic factors occurred over the 30 years of study. It may be that later born cohorts, not faced with an everyday struggle to fulfill basic needs, may demand more of life and thus feel more depressed in spite of objectively having a higher standard of living. Elderly today may also be more emotionally sensitive to changes occurring with aging in a time which is highly youth oriented. Age-related changes in e.g. functional ability, self images and somatic health are likely more common at age 75 than at age 70. If so, the prevalence of minor depression should increase more with age in later born cohorts. Indeed, in the first cohort born in the early 20th century, there was no increase in the prevalence of minor depression from age 70 to 75, while the prevalence of minor depression increased from age 70 to 75 years in those born 1930. This is consistent with a study suggesting that depressive symptoms increased with age among women born 1928-44, but decreased with age in those born 1945-58 (Kasen et al. 2003).

Another partial explanation for the increase in minor depression among 75-year-olds may be that a healthy survivor effect was more influential in the 1970s than in the 2000s. The average life expectancy increased in Sweden during the study period from 72 to 77 years in men and from 78 to 82 years in women (Swedish Statistical Bureau, 2011). Thus, it can be assumed that more people with depression survived into old age in the 2000s compared to the 1970s.

However, this should also have influenced the prevalence of major depression. A further explanation may be a survey effect, but the assessors were to a large extent the same as those in 2000-01, they had the same training, questions were asked in the same order and inter-rater reliability was high. We take note of the fact that our prevalence figures of depression are similar to most cross-sectional studies in the elderly, which report a prevalence of depression of around 10%, and a prevalence of major depression of around 3%. (Skoog et al. 1993, b; Beekman et al. 1995; Ernst and Angst, 1995; Palsson and Skoog, 1997; Jorm, 2000; Steffens et al. 2000; Ritchie et al. 2004; Riedel-Heller et al. 2006; McDougall et al. 2007)

Although depression is generally reported to be more common among women than among men (Culbertson, 1997, Grigoriadis and Robinson, 2007), it has been suggested that this gender difference decreases with increasing age (Jorm, 1987). Our findings from 1976-77 support the latter hypothesis, as minor depression was more common in women among 70-year-olds, while there was no gender difference at age 75. However, three decades later, both minor and major depression were more common among women compared to men at that age. Others have reported that the frequency of major depression increased in subsequent birth cohorts of women born before World War II (born 1915-1925), while an increase in men was not observed until birth cohorts born after 1955 (Wickramaratne et al. 1989; Weissman et al. 1993). The finding that sex differences remained between birth cohorts, despite large changes in gender roles (Kasen et al. 2003), has also been reported by others (Kessler et al. 1994).

Major strengths include the study design with general population samples examined with identical methods over a 30 year period, and the fact that the interviews were part of a

comprehensive investigation of aging. Furthermore, the interviews were performed by psychiatrists and psychiatric nurses.

There are also possible limitations and sources of error that need to be addressed. First, although the response rate in this study is relatively high, the response rate declined from 79% in 1976-77 to 66% in 2000-01 and 63% in 2005-06. Although there were no differences between responders and non-responders in 2000-01 and 2005-06 regarding psychiatric disorders, depression and dementia in the Swedish Hospital Discharge Register, we cannot exclude the possibility that dementia and depression were more prevalent among those who declined. Participants might thus be healthier than non-participants, which might have led to underestimation of dementia and depression in our sample. Second, all studies in the elderly include a survival bias, i.e. we only examined those who reached the age of 70. Thus, we cannot make any conclusions regarding previous or life-time occurrence of depression in the cohorts. Third, mental symptoms are sensitive to report to a stranger. However, all interviews were conducted by psychiatrists or experienced psychiatric research nurses using a semi-structured interview. It might also be easier to report mental symptoms to a professional within the context of an examination on different aspects of aging. Fourth, the cohorts were examined by psychiatrists in 1976-77, and by psychiatric research nurses in 2000-01 and 2005-06. The last author (Ingmar Skoog) was trained by those who made the examinations in the 1970s, and in turn trained those who made the examinations in 2000-01 and 2005-06. Inter-rater reliability between the last author and examiners in the 1970s and 2000s was high, which suggests consistency in the interviews over time. Fifth, we were limited to those questions used in the 1970s, and could thus not diagnose dementia according to more modern criteria. Agreement for a dementia diagnosis between the historical and the DSM-III-R criteria was however high (Wancata et al. 2007). Sixth, it has to be emphasized that some of

the subgroups (e.g. men and women) might have been too small to yield statistical power. This might have led to some false negative results.

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