Psychological Medicine, 2001, **31**, 1159–1168. © 2001 Cambridge University Press
DOI: 10.1017/S0033291701004524 Printed in the United Kingdom

The incidence of first-onset depression in a population followed from the age of 70 to 85[1]

S. P. PÁLSSON,[2] S. ÖSTLING AND I. SKOOG

From the Institute of Clinical Neuroscience, Department of Psychiatry, Sahlgrenska University Hospital, Göteborg University, Göteborg, Sweden

ABSTRACT

Background. Due to the limited data available, it is not clear whether the incidence of first-onset depression varies with age in the elderly.

Methods. A representative sample of individuals born 1901–2 ($N = 392$) was examined at the ages of 70, 75, 79, 81, 83 and 85 years by psychiatrists using a semi-structured schedule. Information on depressive episodes was also collected from self-report and examination of case records. Depression was diagnosed according to the DSM-III-R criteria.

Results. The incidence of depression was 12 per 1000 person-years in men and 30 per 1000 person-years in women between the ages of 70 and 85 (sex difference $P = 0{\cdot}001$). The incidence increased from 17 per 1000 person-years (men 8·7, women 23·2, $P = 0{\cdot}007$) between the ages of 70 and 79 to 44 per 1000 person years (men 27·0, women 52·8, $P = 0{\cdot}166$) between 79 and 85 (age difference: RR 2·6, $P < 0{\cdot}001$; men RR 3·1, $P = 0{\cdot}036$; women RR 2·3, $P = 0{\cdot}003$) . A diagnosis of depression was associated with increased mortality and refusal rate during the 15-year follow-up. Previous episodes of depression were associated with an increased risk of further episodes. The prevalence of depression increased from 5·6% at the age of 70 to 13·0% at the age of 85. The lifetime prevalence of depression was 23% in men and 45% in women.

Conclusions. Both the incidence and prevalence of depression increased with age in this longitudinally followed birth cohort, and the incidence was higher in women than in men.

INTRODUCTION

Depression is common in the elderly, with estimates of prevalence for major and minor depression ranging from 10 to 15% (Pálsson & Skoog, 1997; Beekman *et al*. 1999). However, it is not clear whether the frequency of depression increases or decreases with age after the age of 70 (Pálsson & Skoog, 1997; Jorm, 2000). Several cross-sectional studies report that the prevalence of depressive disorders is lower after the age of 65 than in middle life (Kramer *et al*. 1985; Bland *et al*. 1988; Regier *et al*. 1988; Lehtinen *et al*. 1990). Some authors report an increase in the prevalence of depression after the age of 75–80 (Kay *et al*. 1985; Blazer *et al*. 1991; Beekman *et al*. 1995), while others do not (Saunders *et al*. 1993; Steffens *et al*. 2000). Prevalence rates are influenced not only by the occurrence of new cases, but also by the chronicity of the disorder and by its mortalility rate. Depression in the elderly is reported to be associated with both chronicity and mortality (Murphy *et al*. 1988; Sharma *et al*. 1998). Incidence is therefore a better measure than prevalence to study the association between depression and age. Incidence studies on depression in the elderly are rare, the number of new cases in the very old is often small and the follow-up too short to give any conclusions with regard to the association between depression and age.

We examined age-related changes in the incidence of first-onset depression in a rep-

[1] From the gerontological and geriatric population studies in Göteborg, Sweden. Project leader: before 1988, Professor Alvar Svanborg; after 1988, Professor Bertil Steen.

[2] Address for correspondence: Dr Sigurður P. Pálsson, Department of Psychiatry, Sahlgrenska University Hospital, S-413 45 Göteborg, Sweden.

resentative sample from a birth cohort of 70-year-olds born in 1901–2, who were followed for 15 years.

METHOD

In 1971–2, 70-year-old residents in Göteborg, Sweden, born between 1 July 1901 and 30 June 1902 were systematically sampled from the Population Register by selecting subjects born on days ending with 2, 5 and 8 ($N = 1148$) for a comprehensive examination of ageing and age-related disorders (The Gerontological and Geriatic Population Studies in Göteborg) (Rinder *et al*. 1975; Svanborg, 1977). The sample included both community living and institutionalized subjects. The response rate was 85%. All responders were consecutively given index numbers 1 to 5. A subsample comprising those with index numbers 1 and 2 took part in the psychiatric examination ($N = 392$, 166 men and 226 women). The sample was representative of its population base with regard to sex, marital status, income, community rent allowance, rate of in-patient and out-patient care in psychiatric hospitals, clinics and municipal out-patient departments and rates of registration with the Temperance Board (Persson, 1980).

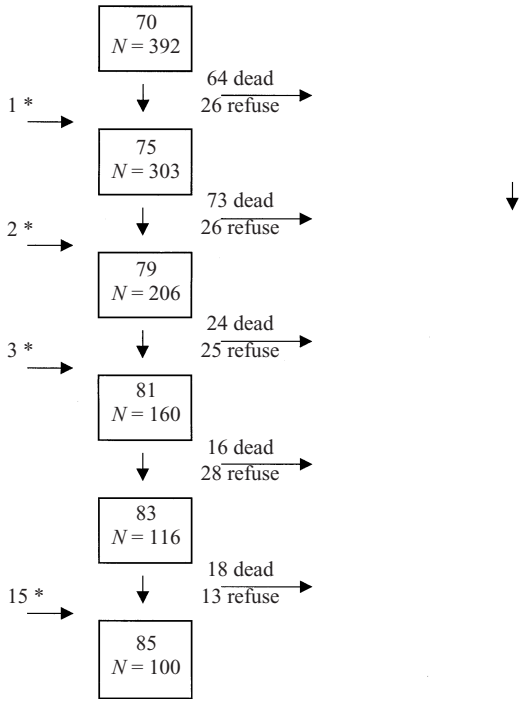

FIG. 1. Description of the psychiatric sample at each age level: base for longitudinal study.
* Some individuals refused to participate at one stage, but all were invited at each stage. Refusals represent those who could not, or would not, participate at each stage.
During the 15 year follow-up, 236 individuals died. In this sample only 195 deaths are shown. This is because 41 of the refusals (who did not participate in the follow-up psychiatric examinations) died during the follow-up period.

The subjects were invited for follow-up examinations at the ages of 75, 79, 81, 83 and 85 years (see Fig. 1). Out of the 392 individuals examined at the age of 70, 236 died during the 15-year study period, 56 were lost due to other reasons, and 100 took part in the final examination at the age of 85. Response rate was thus 64% in those who had survived up to the age of 85. There were no differences between participants and refusals at the age of 85 regarding sex, marital state, mental disorders, treatment for hypertension, cardiovascular disorders, and mean systolic and diastolic blood pressure at the age of 70.

Medical records from general hospitals and homes for the aged, in-patient and out-patient departments in psychiatric hospitals and clinics and municipal psychiatric out-patient departments in Göteborg for all subjects who participated at the age of 70 were examined regarding information on life-time depression and dementia up to the age of 85 (Nilsson, 1984; Skoog *et al*. 1996). Case records were found on 281 individuals (72%). Informed consent was obtained from all subjects, and the study was approved by the Ethics Committee for Medical Research at the University of Göteborg.

The examinations started with a home visit by a registered nurse who interviewed the subjects on their social and living conditions and their social and medical care needs. The participants were also interviewed on their drug consumption. The prescribed and actually taken doses were classified according to the Anatomical Therapeutic Chemical (ATC) classification system recommended by the WHO (Nordic Council on Medicines, 1986).

The participant was then invited for a clinical examination, which included a physical examination by a geriatrician (including history of previous and current diseases), laboratory tests including ECG, chest X-ray, an extensive battery of blood tests and a neuropsychological examination. The psychiatric examination was per-

formed in connection with the physical examination except at the age of 85 when it was performed in the subject's home.

All psychiatric examinations were performed by a psychiatrist. The interviews were semi-structured and included questions on psychiatric symptoms during the month preceding the interview. Psychiatric symptoms and signs were rated in accordance with the Comprehensive Psychopathological Rating Scale (CRPS) (Åsberg *et al*. 1978) at all examinations, except at the age of 70 when a similar scale was used (Persson, 1980; Nilsson & Persson, 1984).

Diagnostic procedures

All diagnoses of depression were made according to the DSM-III-R criteria (American Psychiatric Association, 1987) and included major depressive disorder, dysthymia and depression NOS. The diagnosis from the psychiatric examinations was based on symptoms and signs during the month preceding the examination using an algorithm as described previously (Skoog *et al*. 1993*a*). The diagnosis of depressive episodes based on retrospective information from the participants themselves and from studies of medical records was evaluated by an experienced psychiatrists (S.P.P.) and were only recorded when it caused significant morbidity and functional impairment. It was not possible to make a strict subdiagnosis according to the algorithm in the DSM-III-R from case records and retrospective information, but most of these cases had a severity compatible with a major depression. Normal grief reactions and other emotional reactions on life stressors were not included. Dementia with onset before the depressive episode and concurrent psychotic disorder were exclusion criteria.

The information collected at the examinations from the ages of 70 to 83 did not permit a dementia diagnosis according to the DSM-III-R. The diagnosis of dementia, which was only used as an exclusion criteria in this study, was therefore based on the ICD-9 classification system (WHO, 1977), as described previously (Persson, 1980; Nilsson, 1983, 1984). These diagnoses are similar to the Roth criteria for dementia (Roth, 1955; Roth & Myers, 1969). Severe dementia was defined by at least one rating of severe deficiency in recent or remote memory and/or severe disorientation in time or place. Mild or moderate dementia was defined by at least one rating of moderate severity in these items.

At the age of 85 years, the sample was extended to include all persons in the Population Register of Göteborg born from 1 July 1901 to 30 June 1902, of which a systematic subsample was invited to a psychiatric examination ($N =$ 494, response rate 63%), including the 100 from the original sample (Skoog *et al*. 1993*b*). In this sample, we were also able to make a diagnosis of dementia according to the DSM-III-R criteria (Skoog *et al*. 1993*b*). The criteria used here had a sensitivity of 0·91 and a specificity of 0·95 against the DSM-III-R criteria (WHO, 1997; Persson & Skoog, 1996).

Estimation of incidence

The incidence (I) was based on person-years at risk and computed as:

$$I = \frac{\text{subjects affected in the interval}}{\text{sum of risk years}}.$$

The sum of risk years was computed as follows. First, all persons with a previous or current depression at the age of 70 were excluded. The risk time for those who did not develop depression during the 15 year follow-up was calculated as the time from the first examination to the time of death, development of dementia or the end of follow up (at age 85). For incidence cases where depression was first diagnosed at a psychiatric examination, the individual risk time was calculated as the time from the first examination to the date of the diagnosis of depression. For incidence cases of depression first diagnosed by retrospective information from the participants themselves, the approximation was made that onset of disease occurred in the middle of the period between the last disease-free psychiatric examination and the next examination. For incidence cases of depression first diagnosed by information from case records, the individual risk time was calculated as the time from the first examination to the date of the diagnosis of depression.

Statistical methods

Fisher's exact test was used for comparisons between proportions. Confidence intervals (95% CI) for prevalence rates were calculated by the exact binomial method. Confidence intervals for

incidence rates were calculated by assuming the Poisson distribution. To compare two incidence rates and confidence intervals for their ratio, the relative risk (RR) was calculated by the conditional binomial method, and the binomial test was used to calculate significance. The Mantel–Haenszel (M–H) procedure was used for analysing losses (refusal, mortality) and chronicity in relation to depression. The odds ratio (OR) and test-based (95% CI) were calculated (Kleinbaum *et al*. 1982). Sex by age interaction was analysed using a Cox regression model.

RESULTS

Fifty-four individuals (14% of the sample, 22 men and 32 women) had an episode of depression before the age of 70. Of these, eight were diagnosed according to medical records only, 25 were diagnosed using information from the participants themselves and in 21 cases were diagnosed using information from both sources. A further 16 individuals were diagnosed with depression for the first time at the age of 70. The 70 individuals with a history of previous depression or depression at age 70 were excluded from further analyses, leaving 322 who did not have current or previous depression or dementia at the age of 70. Among these, 70 new cases of depression were diagnosed during the 15-year follow-up (49 from the psychiatric examinations and 21 from interval data (8 from the participants themselves only, 9 from case records only and in 4 cases from both sources)) (Table 1). Among those diagnosed from the psychiatric examination, 20 had major depressive syndrome, 28 had dysthymia, and one had depression NOS. The total lifetime prevalence of depression was thus 35·6% ($N = 140$) (22·7% ($N = 38$) in men and 45·1% ($N = 102$) in women; $P < 0·001$, Fisher's exact test).

The incidence of first-onset depression between the age of 70 and 85 was 11·9 per 1000 risk-years in men and 29·9 per 1000 risk-year in women ($P = 0·001$), and it was higher between the ages of 79 and 85 than between the ages of 70 and 79 (Table 2). A Cox regression model showed no age by sex interaction (data not

Table 1. *The time sequence in which episodes of depressive disorder first occurred*

	N
Number of subjects at the age of 70	392
Depression before or at the age of 70	70
Number alive and at risk at the age of 70	322
New cases of depression between the ages of 70 to 75	18
New cases of depression at the age of 75	6
Cases excluded because of dementia before depression from the ages of 70 to 75	12
Cases excluded because of death before depression between the ages of 70 to 75	51
Number alive and at risk at the age of 75	236*
New cases of depression between the ages of 75 to 79	7
New cases of depression at the age of 79	11
Cases excluded because of dementia before depression from the ages of 75 to 79	19
Cases excluded because of death before depression between the ages of 75 to 79	45
Number alive and at risk at the age of 79	154
New cases of depression between the ages of 79 to 81	4
New cases of depression at the age of 81	7
Cases excluded because of dementia before depression from the ages of 79 to 81	5
Cases excluded because of death before depression between the ages of 79 to 81	10
Number alive and at risk at the age of 81	128
New cases of depression between the ages of 81 to 83	2
New cases of depression at the age of 83	8
Cases excluded because of dementia before depression from the ages of 81 to 83	4
Cases excluded because of death before depression between the ages of 81 to 83	7
Number alive and at risk at the age of 83	107
New cases of depression between the ages of 83 to 85	2
New cases of depression at the age of 85	5
Cases excluded because of dementia before depression from the ages of 83 to 85	2
Cases excluded because of death before depression between the ages of 83 to 85	4

Numbers at risk refers to persons without a previous history or diagnosis of depression or dementia.
* One male entered at the age of 75, invited at the age of 70 but did not participate.

https://doi.org/10.1017/S0033291701004524 Published online by Cambridge University Press

Table 2. *The incidence rates for depressive disorder in a birth cohort followed from the age of* 70 *to* 85

Age interval		Number of new cases of depression	Sum of risk years	Incidence of depression per 1000 years-at-risk	(95% CI)	Sex difference *P*
70–85	Men	15	1259	11·9	(6·7–19·7)	0·001
	Women	55	1841	29·9	(22·5–38·9)	
	Total	70	3100	22·6	(17·6–28·5)	
70–79	Men	9	1035	8·7	(4·0–16·5)	0·007
	Women	33	1424	23·2	(15·9–32·5)	
	Total	42	2459	17·1	(12·3–23·1)	
79–85	Men	6	223	27·0	(9·9–58·4)	0·166
	Women	22	417	52·8	(33·1–79·9)	
	Total	28	640	43·7	(29·1–63·2)	
70–75	Men	6	732	8·2	(3·0–17·8)	0·065
	Women	18	923	19·5	(11·6–30·8)	
	Total	24	1655	14·5	(9·3–21·6)	
75–79	Men	3	304	9·9	(2·0–28·9)	0·087
	Women	15	501	29·9	(16·7–49·4)	
	Total	18	805	22·4	(13·3–35·3)	
79–81	Men	3	99	30·3	(6·2–88·5)	0·759
	Women	8	192	41·6	(18·0–82·0)	
	Total	11	291	37·8	(18·8–67·6)	
81–83	Men	1	58	17·3	(0·4–96·2)	0·180
	Women	9	109	82·6	(37·8–156·9)	
	Total	10	167	59·9	(28·7–110·2)	
83–85	Men	2	66	30·1	(3·6–108·6)	1·000
	Women	5	116	43·2	(14·0–100·7)	
	Total	7	182	38·4	(15·4–79·1)	

Incidence of depression age 79 to 85 *v.* age 70 to 79, RR (95% CI): all, 2·6 (1·5–4·2), $P < 0·001$; women, 2·3 (1·3–4·0), $P = 0·003$; men, 3·1 (0·9–9·7), $P = 0·036$.

Table 3. *The* 1 *month prevalence of depression from the age of* 70 *to* 85 *according to DSM-III-R criteria*

	Age											
	70 ($N = 392$)		75 ($N = 303$)		79 ($N = 206$)		81 ($N = 160$)		83 ($N = 116$)		85 ($N = 100$)	
Any current depressive disorder	% (95% CI)	(*N*)	% (95% CI)	(*N*)	% (95% CI)	(*N*)	% (95% CI)	(*N*)	% (95% CI)	(*N*)	% (95% CI)	(*N*)
All	5·6 (3·5–8·4)	(22)	5·9 (3·6–9·2)	(18)	11·2 (7·2–16·3)	(23)	11·3 (6·8–17·2)	(18)	13·8 (8·1–21·4)	(16)	13·0 (7·1–21·2)	(13)
Men	1·2 (0·1–4·3)	(2)	5·1 (1·9–10·9)	(6)	6·0 (1·7–14·8)	(4)	10·0 (3·4–22·2)	(5)	5·6 (0·7–18·7)	(2)	16·0 (4·5–36·1)	(4)
Women	8·8*** (5·5–13·3)	(20)	6·4 (3·4–11·0)	(12)	13·7 (8·4–20·5)	(19)	11·8 (6·4–19·4)	(13)	17·5 (9·9–27·6)	(14)	12·0 (5·6–21·6)	(9)

N = number of subjects.
Sex difference: ***$P < 0·001$.

shown). Those with depression dropped out more often than other individuals during the 15-year follow-up period (M–H odds ratio (OR) 2·4, 95% CI 1·5–3·8; $\chi^2_1 = 13·1$, $P < 0·001$), both due to death (OR 2·3, 95% CI 1·3–3·9; $\chi^2_1 = 8·3$, $P < 0·01$) and refusal (OR 2·5, 95% CI 1·3–4·8; $\chi^2_1 = 7·4$, $P < 0·05$).

The lowest 1-month prevalence of depression was found at the ages of 70 and 75, and the highest from the age 79 to age 85 (Table 3). Depression was more common in women than in men at the age of 70 (8·8% *v.* 1·2%; $P = 0·001$, Fisher's exact test), but there were no other significant sex differences.

https://doi.org/10.1017/S0033291701004524 Published online by Cambridge University Press

Table 4. *Use of psychotropic drugs in relation to depressive disorder*

Drugs used	Age 70 (*N* = 392) *N* (%)	75 (*N* = 303) *N* (%)	79 (*N* = 206) *N* (%)	81 (*N* = 160) *N* (%)	83 (*N* = 116) *N* (%)	85 (*N* = 100) *N* (%)
Antidepressant						
No mental disorder	7 (2·1)	14 (5·5)	10 (6·6)	5 (4·4)	3 (4·1)	3 (6·3)
Depressive disorder	3 (13·6)	4 (22·2)*	3 (13·0)	5 (27·8)*	1 (6·3)	2 (15·4)
Anxiolytic						
No mental disorder	79 (23·1)	56 (21·9)	40 (26·5)	31 (27·2)	18 (24·3)	11 (22·9)
Depressive disorder	8 (36·4)	8 (44·4)	17 (73·9)***	11 (61·1)*	9 (56·3)	7 (53·8)*
Neuroleptic						
No mental disorder	6 (1·8)	2 (0·8)	3 (2·0)	1 (0·9)	2 (2·7)	3 (6·3)
Depressive disorder	3 (13·6)	4 (22·2)***	4 (17·4)*	2 (11·1)	1 (6·3)	4 (30·8)*
Any psychotropic						
No mental disorder	83 (24·3)	68 (26·6)	48 (31·8)	32 (28·1)	19 (25·7)	16 (33·3)
Depressive disorder	10 (45·5)	11 (61·1)**	19 (82·6)***	13 (72·2)**	10 (62·5)	8 (61·5)

Difference compared with subject without a mental disorder: *$P < 0{\cdot}05$; **$P < 0{\cdot}01$; ***$P < 0{\cdot}001$.

Between 22% and 50% of those with depression at one examination had depression also at the following examination. A diagnosis of depression at age 75 was associated with an increased risk for depression at age 79 (OR 8·9, 95% CI 2·7–29·4; $P = 0{\cdot}002$), depression at age 79 was associated with an increased risk for depression at age 81 (OR 5·4, 95% CI 1·7–17·0; $P = 0{\cdot}013$), depression at age 81 was associated with an increased risk for depression at age 83 (OR 9·3, 95% CI 2·8–30·4; $P = 0{\cdot}001$), while depression at age 83 and age 70 was not significantly associated with depression at the following examination.

Only a minority (range 6–28%) of those with depression at the different examinations were prescribed antidepressants (Table 4), while the prescription rate of anxiolytic-sedatives was high (range 36–74%). The use of anxiolytics-sedative in the mentally healthy was also high (range 22–27%). The prescription pattern of psychotropic drugs did not change with age.

DISCUSSION

We found that the prevalence and incidence of depressive disorders increased with age in a birth cohort followed from the age of 70 to 85, despite both the mortality and refusal rate being higher in those with depression. We also found that the lifetime prevalence of depression was high (23% in men and 45% in women), this was similar to a previous Swedish study (Rorsman *et al.* 1990).

There is a debate on whether age influences the risk of depression (Pálsson & Skoog, 1997; Jorm, 2000). We noted the lowest prevalence of depression at the ages of 70 and 75 years and an increase from the age of 79 and above. In line with other studies (Pálsson & Skoog, 1997; Sharma *et al.* 1998), depression at one examination increased the risk for depression at follow-up. This may be one reason for the increasing prevalence, but we could not elucidate whether the risk of chronicity increased with age due to the small sample sizes. On the other hand, depression was related to a higher mortality and refusal rate during follow-up, which might decrease the prevalence. Incidence is therefore a better measure to study the relation between age and depression.

We found that the incidence of depression increased from 17 to 44 per 1000 person-years between the ages of 70–79 and 79–85. No other study has examined whether the incidence of depression is affected by age in the higher age ranges, but the Epidemiologic Catchment Area (ECA) study reported that the incidence of depression was lower after the age of 65 than in younger age groups (Eaton *et al.* 1989). Studies on representative samples that treat those aged over 65 as one entity are, however, heavily weighted towards the age strata 65 to 75, and the sample aged over 75 is therefore concealed in this type of study. In this paper we were not able to test whether the increase in the incidence of depression with age was due to age alone or to factors such as physical disorders, disability, bereavement, loneliness, institutionalization or

subtle organic or neurochemical brain changes. We will analyse these factors and report results in subsequent papers.

The incidence of depression was 23 per 1000 person-years between the ages of 70 and 85 (12 in men, 30 in women). Our figures are similar, but in the higher ranges, than most other studies. The incidence of first-onset depression per 1000 person-years in the age group 65 and above was 13 in the ECA study (Eaton *et al*. 1989), 7 in males and 12 in women in the age group 74 to 85 years in Iceland (Magnússon, 1989), 14 after the age of 75 in Stockholm (Forsell & Winblad, 1999), and 2 for males and 8 for females in 70–79-year-olds from the Lundby study (Rorsman *et al*. 1990). In studies, excluding depressed individuals at baseline but not those with a history of previous depression, the incidence of depression was 24 in Liverpool (Copeland *et al*. 1992), 16 in Botany, Australia (Snowdon & Lane, 1995) and 15 in London (Blanchard *et al*. 1994). One reason for our somewhat higher incidence figure may be that we included not only major depression but also other varieties of clinically relevant depression. However, among the studies cited, only Eaton *et al*. (1989) and Forsell & Winblad (1999) used the criteria for major depression.

It has been suggested that the female preponderance in the prevalence of depression diminishes with increasing age (Jorm, 1987), which was also noted in our study. However, at all ages the incidence of depression was higher in women than in men. We found that the sex difference did not change over time, which indicates that women are at increased risk for first-onset depression throughout the lifespan.

Several methodological factors have to be considered. Most studies define incidence as the number of individuals free of the disorders at baseline, who have the disorder at the follow-up examination, divided by the time between the examinations. This approach works well when chronic disorders such as dementia are studied but may underrate the incidence of depression. Depression often has remitting course and a new event may have started and ended between the examinations. Furthermore, dropouts have not been included in the calculations in most studies (Eaton *et al*. 1989), which may decrease the incidence of depression as dropout-rate is related to depression. We used information from the individuals themselves and from case records to elucidate what had happened before the study started and between the examinations, and case records to detect depression in dropouts. Case records may lack sufficient information to diagnose depression and generally under-report psychiatric disorders. Retrospective information from the participants themselves may also underrate depression, as some persons might not remember all events or may conceal them from the investigator. Recall bias may be especially evident in the elderly. These notions may be supported by the finding that most incidence cases in our study were detected at the psychiatric examination. Others have reported that only a minority of depressed subjects above the age of 65 report a previous psychiatric history (Van Ojen *et al*. 1995) and only 14% of those examined at the age of 70 in our study had a previous history of depression, despite that we managed to find case records for 72% of our sample. Our case finding method is thus a mixture. The potential effect of such a mixture is not clear, however it is likely that our method may detect more cases than studies relying on examination only.

All interviews and evaluations followed a semi-structured schedule and were carried out by psychiatrists, which is rare in population studies (Jorm, 2000). A psychiatrist has more experience in uncovering symptoms and has more training in observing behavioural signs than a lay-interviewer, indicating that the depression diagnosed in this study is comparable to what a psychiatrist would regard as clinical syndrome. There is no clear gold standard for judging the validity of a depression diagnosis, but standardized clinical diagnosis or rating of clinical symptoms is assumed to be superior to other methods (Jorm, 2000). Three different psychiatrists performed the examinations during the 15-year period. The inter-rater reliability between the psychiatrists in the study was high (Persson, 1980; Nilsson & Persson, 1984; Skoog *et al*. 1993*a*), but it is possible that differences between investigators in evaluating symptoms and signs may have influenced the prevalence and incidence rates. However, the increase in the prevalence of depression started between the ages of 75 and 79, and the same psychiatrist performed these examinations. Case records were evaluated by a fourth psychiatrist (S.P.P.),

who was trained and supervised by the other three.

The cut-off level for caseness of depression may influence the incidence of depression in different directions. For example, a high cut-off may underrate the diagnosis of depression, but may still lead to a higher incidence over the follow-up period, as more subcases at baseline will be included in the population at risk (Gallo *et al.* 1997; Sharma *et al.* 1998). All diagnoses at the psychiatric examinations were based on operationalized research criteria. We might therefore have underestimated depression in individuals who suffered from a clinically relevant depression but did not fulfil the criteria. This may be especially relevant in the elderly where depression often has an atypical picture (Gallo *et al.* 1997). Furthermore, the use of psychotropic drugs was not considered in the diagnosis. Some persons on antidepressants might have fulfilled the criteria if they had not been on treatment, thus underestimating the number of persons with depressive disorders. However, the use of psychotropic drugs in individuals without a diagnosis was similar at the different examinations and could not explain the age differences. The DSM-III-R criteria for depression may overdiagnose depression in the elderly as some symptoms overlap with physical diseases. On the other hand, if depressive symptoms are falsely thought to be due to physical diseases or normal ageing the rate of depression may be underestimated. The use of case records and self-report precluded an exact diagnosis of the type of depression for interval data. We, therefore, had to include not only major depression, but other varieties of clinically relevant depression as well. This might have overestimated our incidence figures for depression compared to other studies, although the depression diagnosed on interval data had to cause significant distress and loss of functioning, compatible with a diagnosis of major depressive syndrome or severe dysthymia. Furthermore, transition between different categories of depression is common over the lifespan (Chen *et al.* 2000).

Sample characteristics may also influence the results. First, the efforts made to exclude persons with a history of previous depression from the population at risk at baseline may differ between studies, and it is difficult to elucidate episodes that might have occurred decades before the examination. Some of those who were defined at baseline as 'never depressed' might have had a previous depression, which might overestimate our incidence rates as persons with a previous history of depression were at increased risk for a new episode. Secondly, dementia is an exclusion criterion for depression according to the DSM-III-R and several other criteria. The prevalence of dementia increases with age to almost 30% at the age of 85 (Skoog *et al.* 1993*b*). Thus, with increasing age, a large proportion of the population is, by definition, removed from the population 'at risk' for depression, giving a lower 'total' prevalence of depression at high ages. If demented individuals are not removed from the denominator, the incidence and prevalence of depression at higher ages will be underestimated, which may be one reason why the frequency of depression seems to decrease with age in some studies (Pálsson & Skoog, 1997). Indeed, Saunders *et al.* (1993) reported that the apparent decline with age disappeared if demented individuals were excluded. Subjects were therefore eliminated from the risk-time calculation at the time of dementia onset (if it appeared before first-onset of depression). Unfortunately, dementia could not be diagnosed according to the DSM-III-R due to lack of information in the studies before the age of 85. The influence that this might have had on the incidence of depression is difficult to interpret. Thirdly, institutionalized individuals, who are reported to have a high prevalence of depressive disorders (Pálsson & Skoog, 1997), were included in our study. The rate of institutionalization increases with age. Studies, which exclude institutionalized subjects may therefore underrate the association between depression and age. Fourthly, a problem shared with all longitudinal studies is that even low rates of dropouts accumulate to give less and less representativeness. Depression was related to non-response due to both refusal and death, which might have underestimated the frequency of depression in the higher age groups. The samples studied at the age of 70 and 85 were, however, found to be representative of all 70 and 85-year-olds in the birth cohort (Persson, 1984; Skoog *et al.* 1993*b*), and we used complementary information from case records to diagnose depression in dropouts.

The calculation of years at risk may differ between studies. We estimated risk-time in dropouts as the time from the first examination until death, first information on depression or dementia in case records or the end of follow-up at the age of 85, not until the last time of examination or information in case records. In those who were diagnosed with depression at the examinations, we estimated risk time until the date of examination, although the depression probably had had its onset earlier. Both of these calculations might have led to an overestimation of risk time in the denominator, and thus to a lower incidence rate. Finally, the number of subjects and risk-years were rather low in the examinations from the ages of 81 to 85. The frequencies in these groups should therefore be taken cautiously.

During the twentieth century, a cohort effect with higher prevalences and earlier onset of depression has been reported in later-born generations (Kessler *et al*. 1994). Therefore, even if the frequency of depression is unaffected by age, the cohort effect may give a lower prevalence in the oldest age groups in cross-sectional studies and in incidence studies with short follow-ups. The age-effect was not distorted by the birth cohort effect of depression in our study, as all individuals were from the same birth cohort. However, later-born birth cohorts may exhibit different age-effects.

Few natural follow-up studies based on the elderly general population have been performed previously (Jorm, 2000) and the usual follow-up time is only a few years. We found in a 15-year follow-up study that depression is a substantial burden throughout late-life. New cases of depression appeared over the whole follow-up period, and the incidence of depression increased with age. This should alert the clinician to look continuously for signs and symptoms of depression in elder patients including those who have no history of previous depressions.

We thank Ms Birgitta Tengelin and Yvonne Sundin for technical assistance. This study was supported by grants from the Swedish Medical Research Council (Grants no. 11337, 11267), the Swedish Council for Social Research (Grant no. 0914), Stiftelsen Söderström-Königska Sjukhemmet, Konung Gustaf V:s och Drottning Victorias Stiftelse, Stiftelsen för Gamla Tjänarinnor, Handlanden Hjalmar Svenssons Forskningsfond, Stiftelsen Professor Bror Gadelius' Minnesfond, The Swedish Society of Medicine, The Göteborg Medical Society, Alma och Anna Yhlen's Foundation.

REFERENCES

American Psychiatric Association (1987). *Diagnostic and Statistical Manual of Mental Disorders, 3rd edn, Revised*. American Psychiatric Association: Washington, DC.

Åsberg, M., Perris, C., Schalling, D. & Sedvall, G. (1978). The CPRS – development and applications of a psychiatric rating scale. *Acta Psychiatrica Scandinavica* (suppl. 271).

Beekman, A. T. F., Deeg, D. J. H., van Tilburg, T., Smit, J. H., Hooijer, Ch. & van Tilburg, W. (1995). Major and minor depression in later life: a study of prevalence and risk factors. *Journal of Affective Disorders* **36**, 65–75.

Beekman, A. T. F., Copeland, J. R. M. & Prince, M. J. (1999). Review of community prevalence of depression in later life. *British Journal of Psychiatry* **174**, 307–311.

Blanchard, M. R., Waterreus, A. & Mann, A. H. (1994). The nature of depression among older people in Inner London, and the contact with primary care. *British Journal of Psychiatry* **164**, 396–402.

Bland, R. C., Newman, S. C. & Orn, H. (1988). Prevalence of psychiatric disorders in the elderly in Edmonton. *Acta Psychiatrica Scandinavica* **77** (suppl. 338), 57–63.

Blazer, D., Burchett, B., Service, C. & George, L. K. (1991). The association of age and depression among the elderly: an epidemiological exploration. *Journal of Gerontology* **46**, M210–215.

Chen, L-S., Eaton, W. W., Gallo, J. J., Nestadt, G. & Crum, R. M. (2000). Empirical examination of current depression categories in a population study: symptoms, course and risk factors. *American Journal of Psychiatry* **157**, 573–580.

Copeland, J. R. M., Davidson, I. A., Dewey, M. E., Gillmore, C., Larkin, B. A., McWilliam, C., Saunders, P. A., Scott, A., Sharma, V. & Sullivan, C. (1992). Alzheimer's disease, other dementias, depression and pseudodementia: prevalence, incidence and three-year outcome in Liverpool. *British Journal of Psychiatry* **161**, 230–239.

Eaton, W. W., Kramer, M., Anthony, J. C., Dryman, A., Shapiro, S. & Locke, B. Z. (1989). The incidence of specific DIS/DSM-III mental disorders: data from the NIMH Epidemiologic Catchment Area Program. *Acta Psychiatrica Scandinavica* **79**, 163–178.

Forsell, Y. & Winblad, B. (1999). Incidence of major depression in a very elderly population. *International Journal of Geriatric Psychiatry* **14**, 368–372.

Gallo, J. J., Rabins, P. V., Lyketsos, C. G., Tien, A. Y. & Anthony, J. C. (1997). Depression without sadness: functional outcomes of nondysphoric depression in later life. *Journal of the American Geriatric Society* **45**, 570–578.

Jorm, A. F. (1987). Sex and age differences in depression: a quantitative synthesis of published research. *Australian and New Zealand Journal of Psychiatry* **21**, 46–53.

Jorm, A. F. (2000). Does old age reduce the risk of anxiety and depression? A review of epidemiological studies across the adult life span. *Psychological Medicine* **30**, 11–22.

Kay, D. W. K., Henderson, A. S., Scott, R., Wilson, J., Rickwood, D. & Grayson, D. A. (1985). Dementia and depression among elderly living in the Hobart community: the effect of the diagnostic criteria on the prevalence rates. *Psychological Medicine* **15**, 771–788.

Kessler, R. C., McGonagle, K. A., Nelson, C. B., Hughes, M., Swartz, M. & Blazer, D. G. (1994). Sex and depression in the National Comorbidity Survey. II: Cohort effects. *Journal of Affective Disorders* **30**, 15–26.

Kleinbaum, D. G., Kupper, L. L. & Morgenstern, H. (1982). *Epidemiologic Research. Principles and Quantitative Methods*. Van Nostrand Reinhold: New York.

Kramer, M., German, P. S., Anthony, J. C., Von Korff, M. & Skinner, E. A. (1985). Patterns of mental disorders among the elderly residents of Eastern Baltimore. *Journal of the American Geriatric Society* **33**, 236–245.

Lehtinen, V., Joukamaa, M., Lahtela, K., Raitasalo, R., Jyrkinen, E., Maatela, J. & Aromaa, A. (1990). Prevalence of mental disorders among adults in Finland. Basic results from the Mini-Finland Health Survey. *Acta Psychiatrica Scandinavica* **81**, 418–425.

Magnússon, H. (1989). Mental health of octogenarians in Iceland. An epidemiological study. *Acta Psychiatrica Scandinavica* **79** (suppl. 349), 1–112.

Murphy, E., Smith, R., Lindesay, J. & Slattery, J. (1988). Increased mortality rates in late-life depression. *British Journal of Psychiatry* **152**, 347–353.

Nordic Council on Medicines (1986). *Nordic Statistics on Medicines 1981–83. Guidelines for ATC Classification*. NLN publication, No. 14: Oslo.

Nilsson, L. V. (1983). Prevalence of mental disorders in a 70-year-old urban sample. A cohort comparison. *Journal of Experimental Gerontology* **5**, 101–120.

Nilsson, L. V. (1984). Incidence of severe dementia in an urban sample followed from 70–79 years of age. *Acta Psychiatrica Scandinavica* **70**, 478–486.

Nilsson, L. V. & Persson, G. (1984). Prevalence of mental disorders in an urban sample examined at 70, 75 and 79 years of age. *Acta Psychiatrica Scandinavica* **69**, 519–527.

Pálsson, S. & Skoog, I. (1997). The epidemiology of affective disorders in the elderly: a review. *International Clinical Psychopharmacology* **12** (suppl. 7), S3–S13.

Persson, G. (1980). Prevalence of mental disorders in a 70-year-old urban population. *Acta Psychiatrica Scandinavica* **62**, 119–139.

Persson, G. & Skoog, I. (1996). A prospective population study of psychosocial risk factors for late onset dementia. *International Journal of Geriatric Psychiatry* **11**, 15–22.

Regier, D. A., Boyd, J. H., Burke, Jr, J. D., Rae, D. S., Myers, J. K., Kramer, M., Robins, L. N., George, L. K., Karno, M. & Locke, B. Z. (1988). One-month prevalence of mental disorders in the United States. Based on five Epidemiologic Catchment Area Sites. *Archives of General Psychiatry* **45**, 977–985.

Rinder, L., Roupe, S., Steen, B. & Svanborg, A. (1975). Seventy-year-old people in Gothenburg. A population study in an industrialized Swedish city. I. General presentation of the study. *Acta Medica Scandinavica* **198**, 397–407.

Roth, M. (1955). The natural history of mental disorder in old age. *Journal of Mental Science* **101**, 281–301.

Roth, M. & Myers, D. H. (1969). The diagnosis of dementia. *British Journal of Hospital Medicine*, March, 705–717.

Rorsman, B., Gräsbeck, A., Hagnell, O., Lanke, J., Öhman, R., Öjesjö, L. & Otterbeck, L. (1990). A prospective study of first-incidence depression. The Lundby study, 1957–1972. *British Journal of Psychiatry* **156**, 336–342.

Saunders, P. A., Copeland, J. R. M., Dewey, M. E., Gilmore, C., Larkin, B. A., Phaterpekar, H. & Scott, A. (1993). The prevalence of dementia, depression and neurosis in later life: the Liverpool MRC-ALPHA Study. *International Journal of Epidemiology* **22**, 838–847.

Sharma, V. K., Copeland, J. R. M., Dewey, M. E., Lowe, D. & Davidson, I. (1998). Outcome of the depressed elderly living in the community in Liverpool: a 5 year old follow-up. *Psychological Medicine* **28**, 1329–1337.

Skoog, I., Nilsson, L., Landahl, S. & Steen, B. (1993*a*). Mental disorders and the use of psychotropic drugs in an 85-year-old urban population. *International Psychogeriatrics* **15**, 33–48.

Skoog, I., Nilsson, L., Palmertz, B., Andreasson, L-A. & Svanborg, A. (1993*b*). A population-based study of dementia in 85-year-olds. *New England Journal of Medicine* **328**, 153–158.

Skoog, I., Lernfeldt, B., Landahl, S., Palmertz, B., Andreasson, L-A., Nilson, L., Persson, G., Odén, A. & Svanborg, A. (1996). 15-year longitudinal study of blood pressure and dementia. *Lancet* **347**, 1141–45.

Snowdon, J. & Lane, F. (1995). The Botany survey. A longitudinal study of depression and cognitive impairment in an elderly population. *International Journal of Geriatric Psychiatry* **10**, 349–358.

Steffens, D. C., Skoog, I., Norton, M. C., Hart, A. D., Tschanz, J. T., Plassman, B. L., Wyse, B. W., Welsh-Bohemer, K. A. & Breitner, J. C. S. (2000). Prevalence of depression and its treatment in an elderly population. The Cache County, Utah Study. *Archives of General Psychiatry* **57**, 601–607.

Svanborg, A. (1977). Seventy-year-old people in Gothenburg. A population study in an industrialized Swedish city. II. General presentation of social and medical conditions. *Acta Medica Scandinavica* (suppl. 611), 3–37.

Van Ojen, R., Hooijer, C., Jonker, C., Lindeboom, J. & van Tilburg, W. (1995). Late-life depressive disorder in the community, early onset and the decrease of vulnerability with increasing age. *Journal of Affective Disorders* **33**, 159–166.

World Health Organization (1977). *Manual of the International Statistical Classification of Diseases, Injuries and Causes of Death. Based on the Recommendations of the Ninth Revision Conference, 1975, and Adopted by the Twenty-ninth World Health Assembly*. World Health Organization: Geneva.