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Cognitive impairment and depression in the oldest old in a German and in U.S. communities

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Abstract Data on cognitive impairment in the oldest old is reported comparing two different samples, one in Munich, Germany, and the other in the United States (Epidemiologic Catchment Area [ECA] study). In both studies the Mini Mental State Examination (MMSE) was used for assessing cognitive impairment. The Munich sample consisted of 402 and the ECA sample of 827 very old people aged 85 years and above. The results indicate that approximately 40% of each sample scored below 24 points in the MMSE indicating at least mild cognitive impairment. Severe cognitive impairment was found in 13.4% of the Munich and in 14.6% of the American sample. The prevalence of major depression was 1.4% in Munich and 2.0% in the ECA study, and dysthymia was found in 5.1% in the Munich and in 2.0% in the ECA sample aged 85 years and above. Persons living in institutions in both studies more frequently showed signs of cognitive impairment than those living in private households. The ECA sample, but not the Munich sample, showed a significantly higher prevalence of cognitive impairment for females and for the oldest age cohort above 90 years of age. Major depression was more frequent in Munich in persons living in institutions and in the ECA study among the oldest age cohort above 90 years of age. Dysthymia in both studies did not show any association with sociodemographic factors. Most of the excess comorbidity (cognitive impairment and depression) was observed among subjects with mild (and not with severe) cognitive impairment. Very similar prevalence rates were generally found not only for MMSE-based cognitive impairment, but contrary to our expectations, also for major depressive disorder. Our data partially confirm a further increase in the prevalence of cognitive impairment in very old age.

Key words Cognitive impairment · Dementia · Gerontology, Psychiatric epidemiology · Community sample · Mood disorders

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Introduction

Most studies on cognitive impairment in the elderly address the relatively wide age span of people aged 65 years and above (see review by Jorm 1990). Although many of these studies have described a sharp increase in the prevalence of cognitive impairment and dementia from the old to the very oldest age group (Kay et al. 1970; Kaneko et al. 1969; Campbell 1983; Cooper and Sosna 1983; Rorsman et al. 1985; Jorm et al. 1987; Evans 1989), the number of people aged 85 or over in most of these studies has been too small to estimate the prevalence of cognitive impairment or its correlates among the very old. Understanding the epidemiology of cognitive impairment in the very old is especially important given the increasing longevity in western societies with a life expectancy of about 80 years. As the number of very old people increases, their specific health care problems demand greater attention.

In this study the epidemiology of cognitive impairment among the very old, aged 85 and over, is investigated in two different samples. The first is a representative sample of very old people living in Munich, Germany. The second comes from the five-site Epidemiologic Catchment Area (ECA) study in the United States. The purpose of this investigation was threefold. Firstly, the prevalence of cognitive impairment as measured in the Mini Mental State Examination (MMSE) is presented and compared for very old people, aged 85 and over, from the two studies. Secondly, sociodemographic correlates of cognitive

impairment are compared in the two studies. Thirdly, comorbidity of cognitive impairment with depression and dysthymia in the two communities is assessed.

Our contribution is primarily descriptive in nature. However, some specific hypotheses concerning which the existing body of literature is inconclusive are addressed:

1. We expect to find similar prevalence rates for cognitive impairment as measured by the MMSE in the German and the American sample especially when age is taken into account.

2. Concerning major depressive illness we expect to find lower rates in the American sample, because the Diagnostic Interview Schedule (DIS) used in the American sample has been said to undercount depression in the very old relative to clinical assessments (Knauper and Wittchen 1994).

3. It has been suggested by some authors that prevalence rates in very old age may not increase exponentially (Ritchie et al. 1992; Wernicke and Reischies 1994).

4. Based on the literature we expected the higher prevalence rates of cognitive impairment for women (Hofman et al. 1991) and persons not married, and in persons living in institutions (cf. Cooper and Bickel 1989).

Method

Samples

Munich study on the oldest old

The German sample was drawn from the community register of the city of Munich on June 5, 1990. At this time 20415 persons aged 85 years and above were living in Munich. On special request of the subjects, names and addresses could not be obtained for 2052 persons (10%). The remaining population consisted of 18363 persons including persons living in homes for the elderly. A sample of 402 persons representative of this population of very old city residents of Munich was randomly drawn. Of the sample, 358 persons (89.0%) were assessed in an interview conducted by psychiatrically trained physicians. Two persons of the sample (0.5%) could not be reached, and 42 persons (10.5%) refused to participate.

The ECA study

The United States sample was drawn between 1980 and 1983 from five different communities: New Haven, Connecticut; Baltimore, Maryland; St. Louis, Missouri; Durham, North Carolina; and Los Angeles, California. At each site a stratified sample was drawn of community-dwelling residents. Additionally, residents were sampled from institutions (e.g., nursing homes, mental health residential facilities, and prisons). Institutional residents were eligible for inclusion in the survey if (a) the institution was within the catchment area surveyed for the community sample and the resident had lived there for at least 1 year, or (b) if the home address of the resident was within the catchment area and the resident had been in the institution, regardless of location, for less than 1 year (Leaf et al. 1992). The response rate for persons aged 85 years and above was 79%. The difference in the response rates between the Munich and the U.S. study is most likely due to the fact that physicians conducted the Munich study in contrast to trained lay interviewers in the ECA program; physicians were able to elicit a greater cooperation from respondents. Of 827 respondents aged 85 years and over, 278 were interviewed by proxy resulting in 549 respondents eligible for analysis.

Measures

Cognitive impairment

The MMSE (Folstein et al. 1975) was used in both the Munich and the ECA studies. Missing data in the MMSE was supplemented by estimates on the basis of scores in the remaining items if not more than 11 answers were missing. In the Munich study MMSE data was complete in 278 cases, and estimations of some item scores were made in 57 cases (total 335 of 358 persons with MMSE scores). Among the 549 ECA respondents, MMSE data was complete for 367 cases, and an estimated score was calculated for 155 cases, yielding 522 of 549 persons with MMSE scores. A higher percentage of incomplete responses to the MMSE in the ECA study (29.6%) as compared with the Munich study (17.0%) most likely is due to the higher proportion of persons aged 90 years and above among the ECA sample. In this group impairments of vision or hearing, or severe tremor, are more prevalent and are a major source of missing data.

In the Munich study, but not the ECA, other instruments were used to assess dementia and other disorders. Results of these assessments are reported elsewhere (Meller et al. 1993; Fichter et al. 1995).

Depression and dysthymia

In the Munich study depression and dysthymia were diagnosed according to DSM-III-R criteria by a research clinician using the Geriatric Mental State Interview (GMS-A; Copeland et al. 1986, 1987) and the Hamilton Depression Scale (HAMD; Hamilton 1976). In the ECA depression and dysthymia were assessed by the Diagnostic Interview Schedule (DIS), a structured interview administered by lay interviewers (Robins et al. 1981). Computer algorithms use the data from the DIS to generate psychiatric diagnoses consistent with the DSM-III. In contrast to the Munich study in which clinicians were able to determine diagnostic status of all except five respondents, DIS data was complete for only 459 of 549 (nonproxy) ECA respondents. Of the respondents with complete DIS data, only 7 did not have an MMSE score. Respondents lacking DIS diagnoses of major depression or dysthymia predominately scored poorly on the MMSE (51 of 70 scored less than 18 points; 9 of 70 scored 18–23 points). Another 20 respondents have completed neither the DIS nor MMSE assessments.

Demographic characteristics

In both studies assessments were made of gender, age (ages 85–89 years, 90 years and over), marital status at the time of the interview (never married, married, widowed, separated, or divorced), and type of residence (community housing or institution).

Weighting of data

Unlike the simple random sampling design of the Munich study, the ECA data were collected using a complex sampling design. Sampling weights were developed to adjust the data from each of the ECA sites for the site-specific sampling design and for nonresponse. Sample weights are generally used in order to estimate population-based prevalence rates. However, the interpretation of weighted data is somewhat unclear in these analyses, because such a small subset of respondents is considered, and this subset spans five different communities. Furthermore, the number of cases of depression and dysthymia is particularly small, making these estimates particularly volatile when sampling weights are imposed. We therefore chose to present the ECA data using both weighted and unweighted estimates of prevalence rates for comparison purposes. Analyses of correlates, however, are presented unweighted.

Statistical analyses

Point prevalence (P_t) at time t was estimated as the proportion of prevalent cases (C_t) in the study population of size N at time t: $P_t = C_t/N_t$ (see Kleinbaum et al. 1982). On the one hand, association between sex, age-group, marital status and recidence and, on the other, cognitive impairment, major depression and dysthymia was analysed for each sociodemographic variable separately and univariate logistic regression analyses were computed (see Kleinbaum et al. 1982; Hosmer and Lemeshow 1989). In order to account for possible confounding effects, cognitive impairment was also analyzed by multivariate logistic regressions with adjustment of the different sociodemographic variables. Because of the small number of cases, statistics concerning demographic correlates of major depression and dysthymia were calculated only on the basis of univariate statistics only.

Results

The sociodemographic characteristics of the two samples are described in Table 1. In both samples males constituted less than a quarter of the sample aged 85 years and above. About a quarter of the subjects in both samples were aged 90 years and above, and the majority (63–75%) were widowed. About two-thirds of each sample lived in the community while the remainder lived in institutions such as nursing homes or other homes for the elderly.

Table 1 Sociodemographic characteristics of the Munich and Epidemiologic Catchment Area (ECA) samples assessed of age 85+ years samples

	Munich (Germany)		ECA (USA)	
	N (358)	%	*N* (522)	%
Gender				
Female	276	77.1	418	76.1
Male	82	22.9	131	23.9
Age (years)				
90+	91	25.4	169	30.8
85–89	267	74.6	380	69.2
Current marital status				
Never married	51	14.3	35	7.0
Married	66	18.5	68	13.6
Widowed	224	62.9	374	74.9
Divorced/separated	15	4.2	22	4.4
Living situation				
Community	257	71.8	355	64.7
Institution	101	28.2	194	35.3

Prevalence of cognitive impairment and depression

The prevalence rates of cognitive impairment, major depression, and dysthymia are listed in Table 2. Approximately 40% of the Munich sample and 50% of the ECA sample scored < 24 on the MMSE, indicating cognitive impairment. The weighted prevalence rate in the ECA was 38.6%, an estimate very similar to the Munich rate. In the Munich sample 13.4%, and about 14.6% in the weighted ECA sample, showed severe cognitive impairment with an MMSE score below 18 points. The estimated prevalence rates of major depression were also very similar in the two samples: 1.4% in Munich and 1.3% in the ECA (2.0% weighted). The prevalence of dysthymia was somewhat higher in the Munich (5.1%) as compared with the ECA sample (2.4%; 2.0% weighted).

Demographic correlates of cognitive impairment and depression

For the most part, the demographic correlates of cognitive impairment, major depression, and dysthymia were comparable for the Munich and the ECA samples (Table 3). In both samples the prevalence of cognitive impairment (MMS < 24) was significantly higher in persons living in institutions as compared with persons living in private households (Munich sample: univariate logistic regression, odds ratio = 2.15, $P = 0.0024$; multivariate logistic regression simultaneously controlling for each sociodemographic variable, odds ratio = 2.07, $P = 0.0045$. ECA sample: univariate logistic regression, odds ratio = 5.24, $P = < 0.0001$; multivariate logistic regression, odds ratio = 4.85, $P < 0.0001$). In the ECA sample cognitive impairment

Table 2 Prevalence of (MMS) scores and 1-year mood disorders in two representative samples of age 85 years and over

	Munich (Germany)		ECA (USA)		
	N	% (Unweighted)	*N*	% (Unweighted)	% (Weighted)
Cognitive impairment (total)					
None (MMSE 24 +)	202	60.3	263	50.4	61.4
Mild (MMSE 18–23)	28	26.3	148	28.4	24.0
Severe (MMSE < 18)	45	13.4	111	21.3	14.6
Major depression					
No	348	98.6[a]	453	98.7[b]	98.0[b]
Yes	5	1.4[a]	6	1.3[b]	2.0[b]
Dysthymia					
No	335	94.9[a]	448	97.6[b]	98.0[b]
Yes	18	5.1[a]	11	2.4[b]	2.0[b]

[a] Based on DSM-III-R classification by research physician
[b] Based on DIS/DSM-III diagnosis

Table 3 Demographic correlates of mental disorders in two representative samples of age 85 years and over: subgroup prevalence rates

	Cognitive impairment (MMS < 24)[a]				Major depression[b]				Dysthymia[b]			
	Munich		ECA		Munich		ECA		Munich		ECA	
	N	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
Gender												
Male	26	33.3	51	40.5	–	–	1	0.9	4	4.9	1	0.9
Female	207	41.6	208	52.1	5	1.8	5	1.4	14	5.1	10	2.9
Age												
85–89	98	38.7	165	45.3	5	1.9	2	0.6(*)	16	6.1	6	1.8
90+	35	42.7	94	59.5	–	–	4	3.1	2	2.2	5	3.8
Marital status												
Unmarried	112	41.0	232	51.1	5	1.7	4	1.0	14	4.9	10	2.5
Married	20	33.9	27	39.7	–	–	2	3.3	4	6.1	1	1.7
Residence												
Community	86	34.8	128	36.8	1	0.4	5	1.5	13	5.1	7	2.1
Institution	47	53.4**	131	75.3**	4	4.0*	1	0.8	5	5.1	4	3.3

(*) $P < 0.10$
* $P < 0.05$
** $P < 0.01$
[a] Multivariate analyses (logistic regression)
[b] Univariate analyses (logistic regression)

Table 4 Coexistence of cognitive impairment and mood disorders. MDD major depressive disorder

Prevalence of MDD and dysthymia by MMSE scores

	Total *N*		Prevalence MDD				Prevalence of dysthymia			
	Munich	ECA	Munich		ECA		Munich		ECA	
			N	%	*N*	%	*N*	%	*N*	%
MMSE score										
< 24	133	199	–	–	5	2.5	8	2.4	7	3.5
24+	201	253	4	1.2	1	0.4	10	3.0	4	1.6

Prevalence of cognitive impairment by MDD and dysthymia

	Total *N*		Prevalence severe (MMSE < 18)				Prevalence mild (MMSE 18–23)			
	Munich	ECA	Munich		ECA		Munich		ECA	
			N	%	*N*	%	*N*	%	*N*	%
Major depression										
No	330	446	45	13.6	59	13.2	88	26.7	135	30.3
Yes	4	6	–	–	1	16.7	–	–	4	66.7
Dysthymia										
No	316	441	43	13.6	59	13.4	82	25.9	133	30.2
Yes	18	11	2	11.1	1	9.1	6	33.3	6	54.6

NOTE: For one person with major depression the MMSE was missing

was more prevalent among women (univariate logistic regression, odds ratio 1.54, $P = 0.0393$). However, neither gender nor age was statistically significant after controlling for living situation.

Statistics concerning demographic correlates of major depression and dysthymia were calculated on the basis of univariate statistics only because of the small number of cases. In the Munich sample, but not the ECA, the prevalence of major depression was significantly higher for persons living in institutions as compared with persons living in private households (univariate logistic regression, odds ratio = 10.65, $P = 0.035$). In the ECA sample, but not the Munich sample, the prevalence of major depression was higher among the oldest respondents than respondents aged 85–89 years (univariate logistic regression, odds ratio = 5.10, $P = 0.061$). Prevalence rates of dysthymia did not vary by demographic factors in either sample.

Table 4 presents data on the comorbidity between cognitive impairment and mood disorders. In the top part of the table, the prevalence rates of major depression and dysthymia are stratified by cognitive impairment at each study site. In the Munich study no statistically significant association between cognitive impairment and major depression or dysthymia was observed, although all four cases of major depression who had valid MMSE scores scored higher than 23 on the MMSE (prevalence 1.2%). In the ECA study the prevalence of major depression was

higher among respondents with low MMS scores (2.5% vs 0.4%, univariate logistic regression, odds ratio = 6.49, $P = 0.089$). The prevalence of dysthymia did not vary statistically by cognitive impairment in either study.

In the bottom part of Table 4, the prevalence rates of severe (scores less than 18 on the MMSE) and mild (scores ranging from 18 to 23) cognitive impairment are stratified by major depression and dysthymia. Although the numbers become very sparse with this amount of stratification, the table does indicate that most of the excess comorbidity between cognitive impairment and major depression occurs among respondents meeting criteria for mild, rather than severe, impairment on the MMSE. This pattern is strongest in the ECA where the major depression is associated with almost no increase in severe impairment (odds ratio = 1.06, $P = 0.9621$), but a large increase in mild impairment (odds ratio = 2.808, $P = 0.11$).

Discussion

Data from these analyses indicate that the prevalence of cognitive impairment and major depression is similar among the very oldest members of communities in Germany and in the United States. Approximately 40% of each sample scored below 24 on the MMSE, indicating at least mild cognitive impairment. In both studies cognitive impairment was assessed using the same instrument scored in a comparable manner. These data, regardless of the weighting strategy, suggest that although cognitive impairment is highly prevalent in the oldest ages in both the German and the American samples, they also indicate that the prevalence of dementia, per se, is not as high as estimated in the East Boston study (Evans et al. 1989). In a comparison of different methods of assessment and diagnosis (Fichter et al. 1995) it has been shown that dementia rates vary considerably depending on the definition and instrument used for case identification. An advantage of the present study is that in both the German and the ECA study, the same instrument (MMSE) and cut off was used, whereas the method of the study by Evans et al. differed. In both the German and the ECA study cognitive impairment may have been underestimated, because cognitive impairment appeared to be more frequent in subjects with whom the MMSE could not be performed.

Studies on dementia in representative community samples and the very old (Brayne and Calloway 1989; Clarke et al. 1991; Evans et al. 1989; Magnusson 1989, and others) showed very divergent results with dementia rates ranging from 6.8 to 47.2% (for review see Jorm et al. 1987 and Ritchie et al. 1992).

In both the German and the ECA study, cognitive impairment was more frequently found in those living in institutions as compared with those living in private households. Higher rates for cognitive impairment were detected in females as compared with males in the ECA, but not the Munich study. Most studies on the prevalence of dementia reported higher rates for females than for males, but the opposite has also been reported (Rorsman et al. 1985). In the ECA, but not in the Munich study, significantly higher rates were found in the older age cohort aged above 90 years. In their meta-analysis of 30 epidemiological studies on senile dementia conducted since 1980, Ritchie et al. showed indications for a drop in the increase of dementia after age 80 years, suggesting that senile dementia may be age-related, rather than ageing-related. Also, Wernicke and Reischies (1994) found a plateau in the prevalence of dementia in persons aged 90 years and above. In concordance with this analysis Hagnell et al. (1981) had reported a decline in the incidence of dementia in persons aged 85 years and above. Concerning very old age and the prevalence of cognitive impairment, it can be concluded that there is no clear evidence for an exponential increase of dementia in the oldest old cohort.

The prevalence rates for major depression in the two samples were close: 1.3% of the Munich sample and 1.4% of the ECA. The assessment of major depression and dysthymia differed in the two studies. In the Munich study psychiatric status was diagnosed by a psychiatrically trained research physician. In the ECA assessments were conducted by trained lay interviewers using a highly structured interview in which there is no allowance for clinical judgment. Given these differences in methodology, the comparability of the estimate of major depression between the two studies is particularly noteworthy.

One of the major limitations of these data is the large proportion of very old persons for whom we were unable to obtain complete data on cognitive functioning or psychiatric status. This problem is a challenge for all studies of the very old, because so many in this population have physical disabilities, medical illnesses, or cognitive problems, which reduce the likelihood that they will be able or willing to be interviewed. In the Munich study 23 respondents had insufficient information on the MMSE and had to be eliminated from the analysis of cognitive functioning. The problem of missing data was exacerbated by the use of a lay-administered structured interview in the ECA study. Among all the very old in the ECA, 33.6% (278 of 827) were interviewed by proxy. Although proxy data were excluded from these analyses in order to increase the reliability of the assessment, this procedure most likely biases the estimates of both disorders in the very old. For example, a number of respondents ($n = 52$) who were interviewed by proxy did complete their own MMSE. Of these, all but one (98.1%) scored below 24 points, indicating cognitive impairment. Inclusion of respondents who were able to complete the MMSE, but unable to be interviewed by the DIS, would raise the prevalence of cognitive impairment in the ECA to 54.0% (42.4% weighted). However, still omitted in these estimates are the respondents who were unable to complete the MMSE (226 interviewed by proxy and 27 interviewed in person). We do not know if the lack of MMSE information on these respondents is a result of cognitive or other kinds of problems.

The large proportion of very old respondents who were unable to be interviewed with the DIS or from whom information was assessed by proxy also results in problems

in interpreting the prevalence rates of major depression and dysthymia in the ECA. Given the evidence of higher rates of depression and dysthymia among respondents with mild cognitive impairment, we might expect that the disproportionately lower scores on the MMSE among respondents without a DIS assessment would result in even higher rates of depression than estimated. The hypothesis of an underestimation of depression in the very old is also suggested by the higher rates of depression (4.6%) among the 152 respondents with proxy information in the DIS.

These data indicate a high level of comorbidity between cognitive impairment and depression. Although the effect was stronger in the ECA, there was evidence in the Munich data as well. Moreover, one of the respondents missing an MMSE score in the Munich data was diagnosed with depression. The results about the coexistence of cognitive impairment and mood disorders were as follows: Major depression and dysthymia were more prevalent among persons with cognitive impairment as compared with persons without cognitive impairment. A number of epidemiological studies addressed this issue with partially discrepant results. In some studies higher rates of depressive symptoms in association with cognitive impairment have been reported (Kay et al. 1985; Griffiths et al. 1987), whereas Helmchen and Linden (1993) did not confirm such an association. Many studies found that mood disorders were more frequent in mild and moderate, but not in severe, cognitive impairment or dementia (Pearson et al. 1989; Wragg and Jeste 1989; Fischer et al. 1990; Henderson and Hasegawa 1992; Skoog 1993).

One interpretation of the observed comorbidity between mild cognitive impairment and depression is that the MMSE is sensitive to the cognitive symptomatology of depression, e.g., "pseudodementia" as Cummings (1989) has shown. Longitudinal data will be useful in differentiating comorbid cognitive impairment (e.g., dementia) and depression from conditions in which the cognitive symptoms subside with the resolution of the depressive episode. Another interpretation of the observed comorbidity between mild cognitive impairment and depression would be that persons with a mild degree of cognitive impairment are more aware of their increasing impairment and inabilities, and consequently react with depressive symptoms (Cummings 1989). In contrast, depression was infrequent in severe cases of cognitive impairment.

In summary and concerning our hypotheses based on the existing literature, we found very similar prevalence rates not only for MMSE-based cognitive impairment, but contrary to our hypothesis, also for major depressive disorder. Our data partially confirm a further increase in the prevalence of cognitive impairment in very old age. A higher prevalence rate of cognitive impairment for females was confirmed for the American ECA, but not the Munich sample.

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