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ORIGINAL PAPER

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Mortality risk in the octo- and nonagenerians: longitudinal results of an epidemiological follow-up community study

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Abstract The object of the study was the assessment of the mortality risk for persons in a representative two-wave community sample assessed longitudinally. In the first cross-section a total of 358 (89.1%) subjects of Munich, Germany, aged 85 years and above were interviewed by research physicians. One year later 263 (73.5%) persons were reexamined. Death certificate diagnoses were obtained after an interval of 4 years 8 months. 58% of the total sample were deceased. Sociodemographic factors, mental disorders, subjective health status and need for care were analysed in relation to mortality by Cox regression. The probability of death was increased in those diagnosed as having a dementia or depressive disorder, in those of increasing age, living in institutions, being in need of care and of bad health status. In the multi-variate Cox regression model the influence of these different factors was examined and evaluated. Need for care was the most powerful predictor of mortality.

Key words Mortality risk · Epidemiological community study · Mental disorders

Introduction

The increasing longevity in western nations leads to an increasing multimorbidity. Somatic and mental illness change life expectancy. Since Farr's report in 1841 on mortality among lunatics in British asylums and Ödegard's study of excess mortality among the insane in Norway (Ödegard 1952) increased mortality in the mentally ill has been confirmed repeatedly. Resources using patient samples have demonstrated that the effect of psychiatric status on mortality varies by type of psychiatric disorder (Kendler 1986, Tsuang and Simpson 1985). Most studies have dealt with psychiatrically treated patients. Data derived from treated patients are not representative for a community because of selection factors. Mortality data of community samples are particularly important since factors possibly affecting the risk of mortality, such as age or concurrent physical health problems, also affect the help-seeking behaviour for psychiatric problems. From the perspective of community health mortality data can be useful for identifying high risk groups, potentially modifying risk factors and for the planning of health services.

Community studies about the relationship between mortality and mental disorder present mixed results. Some studies undertaken of representative community samples have generally confirmed an increased mortality rate in persons who had previously shown signs of mental illness (Rorsman et al. 1986, Murphy et al. 1987, Madianos et al. 1998).

Bruce and Leaf (1989) found, in the epidemiological catchment area study, mortality associated with depression and alcohol-disorders over the age of 40 years. Weissman et al. (1986), Fredman (1989), Goldberg (1979) and Singer (1976) found no substantial association between depressive symptomatology and increased mortality risk.

In accordance with the literature, in our study the mortality of the octo- and nonagenerians is analysed according to sociodemographic factors like age, gender, living situation, as well as to physical health, need for care and mental disorder, especially depression and dementia.

We were interested in the different influence of different factors on age adjusted relative mortality risk.

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Methods

Sample

The sample was drawn from the community register of the city of Munich. The sampling is described in Meller et al. (1997) and

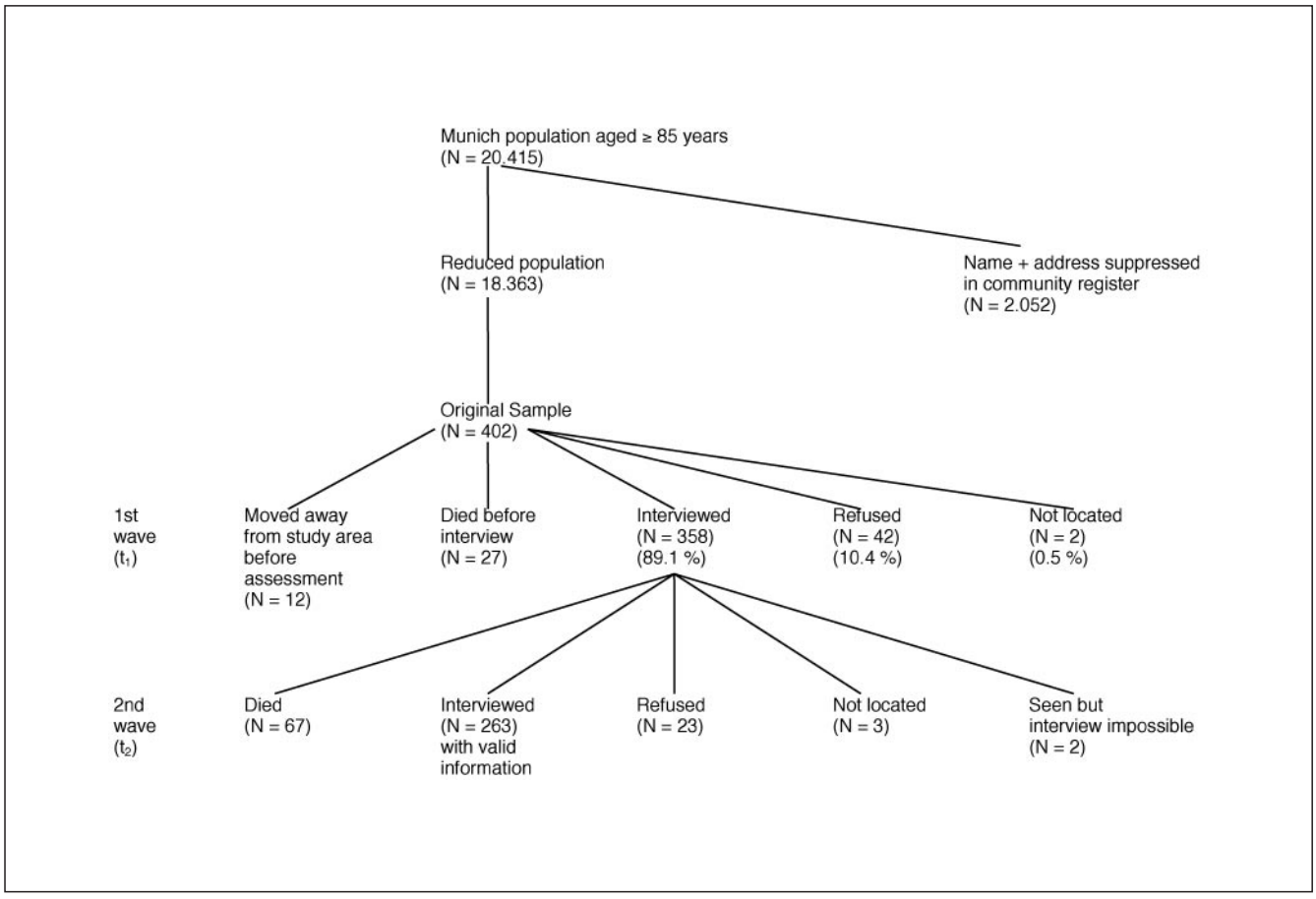

Fig. 1 Sample

Fichter et al. 1995b), papers giving results about depression and dementia. In June 1990 20,415 persons living in Munich City were aged 85 years and above. The names and addresses of 2,052 persons of this population could not be obtained because the data requested were not forwarded (for security reasons). The remaining population consisted of 18,363 persons aged 85 years and above who were registered as residents of the city of Munich, including persons living in homes for the elderly. Out of these 18,363 persons a representative sample of 400 persons was drawn by the procedure SAMPLE of SPSS. Before the first examination 27 subjects were deceased, 12 subjects had moved away according to the information of the community, 2 persons could not be traced. The drop-out of 41 subjects was replaced. The final sample correlated very well to the remaining population of 18,363 persons according to gender, age and living situation. Living situation was classified in three categories: private home, old people's home and nursing ward. The information was based on self-rating, informant's interview and the registration of homes in the community. Nevertheless the problem exists that information about 2,052 persons (10%) of the population 85 years and older was not available. Possible security reasons could include mental illness, biasing the representativity of our sample. Additionally the drop-outs by dying and moving before the first interview are not neutral drop-outs because both facts are possibly influenced by mental disorders. 358 persons (89%) were assessed in the first cross-section in an examination conducted by physicians trained in psychiatry. 263 (73.6%) were re-examined one year later (exact data see Fig. 1). The mortality data were based up to 28 February 1995 and delivered by the community register.

Instruments

The main instrument used to assess psychopathology was the geriatric mental state interview (GMS-A; Copeland et al. 1986, 1987). The high sensitivity and specificity for organic as well as depressive disorders in the elderly has been reported. Results were analysed using the AGECAT (automated geriatric examination for computer programme developed by Copeland et al. 1986). The following diagnoses can be derived (with severity scores ranging from one to five) on the basis of the AGECAT computer programme: organic mental illness (dementia), depression (undifferentiated), depressive neuroses, depressive psychoses, hypochondriasis, anxiety neuroses, obsessive compulsive neurosis, phobia and schizophrenia. The GMS offers only one main diagnosis at the end; on the syndrome-level, however, there is the possibility of several syndromes. In addition, SIDAM, the structured interview of the diagnosis of dementia of Alzheimer-type, multiinfarct-dementia and dementias of other atiology according to DSM-III-R and ICD-10 (SIDAM Zaudig et al. 1990 and 1991) and the Hamilton depression scale (HAMD, Hamilton 1976) were assessed. Diagnosis of mental disorders was made by the AGECAT computer programme according to GMS-A, according to ICD-10 and DSM-III-R by the psychiatrically trained physicians. A project diagnosis took into account the AGECAT computer programme diagnosis, the Hamilton depression scale and SIDAM scale. Case definition procedure is described in Meller et al. (1996) and Fichter et al. (1995b).

Sociodemographic data (age, gender, family state, living situation) were requested. The social class was assessed by Moore and Kleining (1960), unfortunately only in the follow-up – for women the husband's profession determines the social class. Therefore, only 262 persons could be categorized in different social classes. The information is based on the interviewee or on informants. Sub-

jects received a physical examination. The research physician filled out a check-list concerning somatic health problems within the past seven days and the past 12 months. Somatic illness was classified according to ICD-9.

Evaluation of need for care was a global medical judgement being defined as basic care required because of somatic illness, mental disorder or a combination of mental and somatic disorder, categorized according to the time required for support, which may be for medical aid or psychological or social support.

Interviewees were asked for subjective global health estimation categorized in three degrees.

Statistical analyses

Logistic regression solely distinguishes if an event (e.g. death) occurred or not. It may be argued that this kind of analysis yields biased results, especially for the older ages when the overall probability of surviving the entire period is small. One method of dealing with this problem is to include survival time in the analysis by means of Cox regression. Cox regression best takes into account the effect of age. The mortality rate is calculated in dependency of survival time.

For all variables we were interested in, the relative mortality risk was calculated by Cox regression (containing the age as continuous variable and the predictor variable in dummy form). Variables for the Cox regression analysis were sociodemographic factors like age, gender, family state, living situation, social class and mental disorder according to project diagnosis and GMS-Syndrome-Diagnosis, need for care and subjective well-being.

The Cox regression model was also used in order to check for the combined effect of the different variables on patient survival as, with the use of the Cox model, a great advantage is the ability to analyse interactions, i.e. to determine whether the effect of one variable on the mortality risk varies according to the level of a second variable. It is possible that one variable included at first has a significant influence because of its correlation with another which was up to now not included (Blossfeld et al. 1986). The conceptualisation of the model based on hypothetical considerations. A complex model was successively built up by including consequently different variables. We assumed that sociodemographic variables have an influence on somatic status, both on need for care and finally all factors together on the mental status. All variables with significant effect on mortality in the age adjusted Cox regression analysis were included. Changes of variables up to the time of the follow-up examination were considered.

Results

Mortality rate

Out of the sample of 441 subjects which were assessed from the total sample of all Munich citizens 85 and older, 256 (58%) had died by 28 February 1995 within an interval of 4 years and 8 months. For seven persons (1.6%) we were unable to get any information about mortality. Out of the 358 subjects examined in the first wave, 56.7% had died meanwhile. 25 of the 42 refusers (59.5%) were deceased. There was no significant difference in the death rate of interviewees and refusers. Five out of 12 persons who had moved away from Munich City before the examination were dead (Table 1).

Age-adjusted relative mortality risk and sociodemographic data according to Cox regression analysis

With increasing age the risk of mortality increased, too. The age adjusted mortality risk of men was slightly, but not significantly, higher than that of women. There was no significant risk for any particular kind of family-state. Married probands showed a slightly higher mortality risk. Most persons of our sample (67.1%) had already beem widowed or divorced for many years. Upper classes showed significantly less mortality risk. The mortality of subjects living in nursing wards was 2.5 to 3 times higher than for persons living in private households. For women this result was significant. For me, the result could not be proved to be significant because of small case numbers, although the power of effect showed a close relation (Table 2).

Age-adjusted relative mortality risk and mental disorder according to Cox regression analysis

Mortality risk according to project diagnosis

Mental disorders increased the risk of mortality in men and women. The mortality risk for demented men amounted to 2.5 times, for women to 2 times greater in comparison with non-demented subjects. Depression showed a greater influence on mortality for men (1.8 times), than for women (1.4 times). Other psychiatric disorders also demonstrated a negative influence on mortality (Table 3), but there is the problem of low case numbers. Therefore, the interpretation has to be made carefully.

Table 1 Death rate (28.02.1995) according to first cross-section

		Unknown		Alive		Dead		X^2 test		
		n	%	*n*	%	*n*	%	X^2	df	p
t1-examination	N									
Interviewed	(358)			155	43.3	203	56.7	0.122	1	0.727
Refusals	(42)			17	40.5	25	59.5			
Dead before t1*	(27)	1	3.7	4	14.8	22	81.5	–		
Moved away	(12)	5	41.7	2	16.7	5	41.7	–		
Not traceable	(2)	1	50.0			1	50.0			
Total	(441)	7	1.6	178	40.0	256	58.0			

Note: Significance test was Pearson's X^2 test: comparison of the mortality rate of interviewees and refusers
*this information of the community register proved to be faulty

Table 2 Relative mortality risk according to sociodemographic factors

Covariate	Men relative risk			Women relative risk			Total relative risk		
	lower	95% Ci	upper	lower	95% Ci	upper	lower	95% Ci	upper
Age									
85 years		1.00			1.00			1.00	
+ every additional year	1.01^{-1}	1.09	1.20	1.09	1.14	1.20	1.08	1.13	1.18
	Ch = 2.569, df = 1, p = 0.1089			CH = 25.415, df = 1, p = 0.0000			Ch = 27.006, df = 1, p = 0.0000		
Gender									
Women								1.00	
Men							0.78	1.08	1.50
							Ch = 0.227, df = 1, p = 0.6339		
Family state									
Married		1.00			1.00			1.00	
Single	12.69^{-1}	2.92^{-1}	1.48^{-1}	2.27	1.17^{-1}	1.67	2.17^{-1}	1.34^{-1}	1.21
Widowed/divorced	2.38^{-1}	1.29^{-1}	1.42^{-1}	2.26^{-1}	1.26	1.41	1.89^{-1}	1.32^{-1}	1.09
	Ch = 2.853, df = 1, p = 0.2402			Ch = 0.674, df = 1, p = 0.7139			Ch = 2.219, df = 1, p = 0.3298		
Children									
None		1.00			1.00			1.00	
One	1.43^{-1}	1.42	2.88	1.68^{-1}	1.14^{-1}	1.30	1.44^{-1}	1.02^{-1}	1.38
2 or more	1.99^{-1}	1.01^{-1}	1.96	1.85^{-1}	1.28^{-1}	1.33	1.68^{-1}	1.22^{-1}	1.14
	Ch = 1.155, df = 1, p = 0.5612			Ch = 1.685, df = 1, p = 0.4306			Ch = 1.610, df = 1, p = 0.4470		
Social class									
Upper class		1.00			1.00			1.00	
Middle class	1.35^{-1}	2.68	9.66	1.29^{-1}	2.16	6.03	1.01	2.20	4.80
Lower class	3.58^{-1}	1.23	5.39	1.27^{-1}	2.18	6.05	1.15^{-1}	1.90	4.19
	Ch = 4.86, df = 1, p = 0.0881			Ch = 2.950, df = 1, p = 0.2287			Ch = 4.834, df = 1, p = 0.0892		
Living situation									
Private household		1.00			1.00			1.00	
Home	2.12^{-1}	1.12	2.66	1.22^{-1}	1.23	1.86	1.22^{-1}	1.19	1.72
Nursing ward	1.21^{-1}	2.91	10.27	1.59	2.45	3.77	1.64	2.44	3.63
	Ch = 2.203, df = 1, p = 0.3324			Ch = 14.766, df = 1, p = 0.0006			Ch = 16.671, df = 1, p = 0.0002		

Odds ratios on account of Cox regression
Ch improvement of the deviance measure (–2log likelihood) at taking up from the factors compared with the model with aging effect, df1 grade of scope, P probability of error about model improvement

Table 3 Relative mortality risk according to mental disorders (project diagnosis, t1)

Covariate	Men relative risk			Women relative risk			Total relative risk		
	lower	95% Ci	upper	lower	95% Ci	upper	lower	95% Ci	upper
No mental disorder									
no		1.00			1.00			1.00	
yes	4.54^{-1}	2.51^{-1}	1.39^{-1}	2.50^{-1}	1.80^{-1}	1.30^{-1}	2.60^{-1}	1.95^{-1}	1.47^{-1}
	Ch = 9.661, df = 1, p = 0.0019			Ch = 12.873, df = 1, p = 0.0003			Ch = 21.774, df = 1, p = 0.0000		
Dementia									
no		1.00			1.00			1.00	
yes	1.35	2.47	4.50	1.43	1.98	2.75	1.56	2.08	2.77
	Ch = 7.791, df = 1, p = 0.0053			Ch = 15.656, df = 1, p = 0.0001			Ch = 23.032, df = 1, p = 0.0000		
Depression									
no		1.00			1.00			1.00	
yes	1.07^{-1}	1.77	3.38	1.00	1.44	2.06	1.10	1.51	2.07
	Ch= 2.783, df = 1, p = 0.0953			Ch = 3.657, df = 1, p = 0.0558			Ch = 6.125, df = 1, p = 0.0133		
Other mental disorder									
no		1.00			1.00			1.00	
yes	1.20^{-1}	1.80	3.68	1.11	1.66	2.48	19.19	1.69	2.41
	Ch = 1.977, df = 1, p = 0.1598			Ch = 5.559, df = 1, p = 0.0184			Ch = 7.596, df = 1, p = 0.0059		

Odds ratios on account of Cox regression
Ch improvement of the deviance measure (–2log likelihood) at taking up from the factors compared with the model with aging effect; df1 grade of scope, P probability of error about model improvement

Table 4 Relative mortality risk according to mental disorder (GMS-A-Syndrome-diagnoses, t1)

Covariate	Men relative risk			Women relative risk			Total relative risk		
	lower	95% Ci	upper	lower	95% Ci	upper	lower	95% Ci	upper
Demential syndrome									
no		1.00			1.00			1.00	
degree 1–2	1.17^{-1}	1.84	3.94	1.03^{-1}	1.48	2.25	1.09	1.57	2.27
degree 3–5	1.38	2.68	5.23	1.43	2.08	3.03	1.61	2.24	3.10
	Ch = 8.328, df = 1, p = 0.0155			Ch = 14.324, df = 1, p = 0.008			Ch = 22.812, df = 1, p = 0.0000		
Depressive syndrome									
no		1.00			1.00			1.00	
degree 1–2	1.33^{-1}	1.66	3.68	1.07	1.58	2.34	1.14	1.61	2.29
dep. neurosis	1.00	2.03	4.12	1.12	1.77	2.83	1.27	1.86	2.73
dep. psychosis	1.58	4.36	12.03	1.03	1.65	2.66	1.22	1.88	2.88
	Ch = 8.332, df = 1, p = 0.0396			Ch = 9.478, df = 1, p = 0.0236			Ch = 15.688, df = 1, p = 0.0013		
Anxiety syndrome									
no		1.00			1.00			1.00	
degree 1–2	1.15^{-1}	1.65	3.11	1.11^{-1}	1.31	1.90	1.01	1.39	1.91
degree 3–5	1.25^{-1}	2.80	9.77	1.19^{-1}	1.67	3.27	1.02	1.84	3.33
	Ch = 3.652, df = 1, p = 0.1611			Ch = 3.072, df = 1, p = 0.2153			Ch = 5.876, df = 1, p = 0.0530		
Phobic syndrome									
no		1.00			1.00			1.00	
degree 1–2	3.02^{-1}	2.46	18.30	1.80^{-1}	1.51	4.10	1.50^{-1}	1.62	3.97
	Ch = 0.599, df = 1, p = 0.4390			Ch = 0.573, df = 1, p = 0.4490			Ch = 0.980, df = 1, p = 0.3222		
Paranoid syndrome									
no		1.00			1.00			1.00	
degree 1–2	1.71^{-1}	1.31	2.92	1.10	1.64	2.43	1.10	1.57	2.24
degree 3–5	2.26^{-1}	3.37	25.66	1.87^{-1}	1.52	4.33	1.43^{-1}	1.77	4.48
	Ch = 1.334, df = 1, p = 0.5133			Ch = 5.682, df = 1, p = 0.0584			Ch = 6.524, df = 1, p = 0.0383		
Obsessional-compulsive syndrome									
no		1.00			1.00			1.00	
degree 1–2	0.00	$2.27E^{-6}$		4.19^{-1}	1.95^{-1}	1.10	4.95^{-1}	2.32^{-1}	1.08^{-1}
degree 3–5	3.23	2.30	17.11	5.88^{-1}	1.23	8.83	2.46^{-1}	1.65	6.69
	Ch = 5.171, df = 1, p = 0.0754			Ch = 3.648, df = 1, p = 0.1613			Ch = 6.652, df = 1, p = 0.0359		

Odds ratios on account of Cox regression
Ch improvement of the deviance measure (–2log likelihood) at taking up from the factors compared with the model with aging effect; df1 grade of scope, P probability of error about model improvement

Taking all mental disorders together, they showed a significantly higher mortality rate in comparison with mentally healthy subjects.

Mortality risk according to GMS-A-syndrome diagnosis

The mortality risk increased in demented and depressive subjects. The effect was stronger for men than for women. In persons suffering from slight demential and depressive syndromes not fulfilling the definition of caseness, the mortality was slightly higher. Low degrees of obsessive syndrome not fullfilling case definition led to a reduced mortality; higher degrees of obsessive syndromes (3–5) to an increased mortality risk (Table 4).

Age-adjusted relative mortality risk and subjective well-being, need for care and help-seeking behaviour according to Cox regression analysis

The probands subjectively estimated their health status. 56% of our sample estimated subjectively the health status as good or very good. Women estimating a moderate or bad health status in the first cross-section had an increased mortality risk in the following years. The mortality risk for men increased only if the estimation of health status amounted to bad or very bad.

Persons in need of care demonstrated a mortality five times higher than subjects without need for care. 52.2% showed no need for care. Considering the cause of need for care men showed a higher mortality because of mental disorders (4.5) and a combination of mental and somatic disorders (3.4), less for only somatic illness (2.1). In women the need for care caused by a combination of mental and somatic disorders strongly influenced the mortality

Table 5 Relative mortality risk according to subjective health status and need for care, hospital stays and consultation of G. P.

Covariate	Men relative risk			Women relative risk			Total relative risk		
	lower	95% Cl	upper	lower	95% Cl	upper	lower	95% Cl	upper
Subjective health status									
(very) good		1.00			1.00			1.00	
moderate	1.76^{-1}	1.13	2.25	1.38	1.99	2.87	1.26	1.73	2.38
(very) bad	1.08^{-1}	1.94	4.04	1.82	2.83	4.39	1.76	2.56	3.73
	Ch = 2.893, df = 1, p = 0.2354			Ch = 25.260, df = 1, p = 0.0000			Ch = 25.610, df = 1, p = 0.0000		
Need for care									
no		1.00			1.00			1.00	
yes	1.49	2.72	4.99	1.80	2.52	3.52	1.92	2.58	3.45
	Ch = 10.769, df = 1, p = 0.0010			Ch = 30.673, df = 1, p = 0.0000			Ch = 41.934, df = 1, p = 0.0000		
Cause of need for care									
no need for care		1.00			1.00			1.00	
somatic illness	1.03	2.14	4.45	1.33	2.01	3.03	1.44	2.06	2.94
mental illness	1.03	4.53	1.995	1.16^{-1}	1.64	3.14	1.00	1.80	3.26
som. + mental illness	1.65	3.42	7.08	2.53^{-1}	3.91	5.82	2.69	3.81	5.40
	Ch = 12.593, df = 1, p = 0.0056			Ch = 43.107, df = 1, p = 0.0000			Ch = 54.796, df = 1, p = 0.0000		
Hospital stays									
< 1 week		1.00			1.00			1.00	
≥ 1 week	1.76^{-1}	1.08	2.04	1.03^{-1}	1.40	2.03	1.04^{-1}	1.32	1.81
	Ch = 0.051, df = 1, p = 0.8220			Ch = 3.106, df = 1, p = 0.0780			Ch = 2.790, df = 1, p = 0.0948		
Consultation with the GP									
0– 3		1.00			1.00			1.00	
4–12	2.04^{-1}	1.10	2.45	1.22^{-1}	1.45	2.55	1.81^{-1}	1.34	2.12
13+	1.63^{-1}	1.46	3.46	1.18	2.20	3.79	1.26	1.96	3.05
	Ch = 0.924, df = 2, p = 0.6302			Ch = 11.153, df = 2, p = 0.0038			Ch = 11.650, df = 2, p = 0.0030		

Odds ratios on account of Cox regression
Ch improvement of the deviance measure (–2log likelihood) at taking up from the factors compared with the model with aging effect; df1 grade of scope, P probability of error about model improvement

(3.9), need for care because of only mental disorders showed less influence (1.6) (Table 5).

30% of the interviewees had been inpatients for at least one week during the year before the examination. 17.2% had contacted their general practitioner up to three times, 41.6% between four and 12 times and 41.3% more often than 12 times a year. The duration of stay in hospitals one year preceding the first interview revealed no significant effect on mortality, neither for men nor for women. If the frequency of consultations with the general practitioner augmented to 13 consultations per year, the mortality risk significantly increased for women, not for men (Table 5).

Relative mortality risk according to multivariate Cox regression analysis

The social class was unfortunately only exactly explored in the follow-up examination. The inclusion of the variable social class in the multi-variate analyses consequently reduced the sample size and created the problem of selection, as drop-outs of this variable were dependent on mortality. Therefore, in Table 6, four different models are demonstrated without considering social class. The first model considered age and living situation. Every year of age increased the risk of mortality by about 9%. The risk of mortality increased dramatically by 111% for subjects living in a nursing ward. In the second model we also considered somatic illnesses. The risk of mortality increased significantly for subjects suffering from neoplasma (70%), skeleton- and muscle-illness (51%) and from congenital anomalies (153%). The control of somatic illness slightly reduced the effect of living situation. In the third model the need for care was included. If the medical doctors determined need for care because of somatic and mental disorders, the risk of mortality increased by 269%. Need for care because of mental disorders increased the mortality only by 139%, because of somatic illness by 63%. By including the variable need for care the effect of the living situation on mortality was reduced. In the first model only considering age and living situation, persons living in a nursing ward showed an increased mortality of 111%. This effect was reduced to 102% by including somatic illness, and additionally reduced to 31% by including need for care. The increased risk of mortality for persons living in nursing wards is, therefore, based mainly on need for care. The influence of somatic illness on mortality was not changed by including need for care. In the fourth model mental disorders were included besides sociodemographic factors, somatic illness and need for care. Neither the diagnoses of dementia nor those of depression or other mental disorders revealed

Table 6 Relative mortality risk by Cox regressions: stratification by subjective health status – without social class

Covariate	Model 1 relative risk			Model 2 relative risk			Model 3 relative risk			Model 4 relative risk		
	lower	95%	upper	lower	95%	upper	lower	95%	upper	lower	95%	upper
Age	1.04	1.09	1.15	1.05	1.11	1.16	1.04	1.10	1.15	1.05	1.10	1.16
Middle class (t2)	–	–	–	–	–	–	–	–	–	–	–	–
Lower class (t2)	–	–	–	–	–	–	–	–	–	–	–	–
Home[1]	1.28^{-1}	1.14	1.66	1.50^{-1}	1.02	1.45	1.56^{-1}	1.06^{-1}	1.38	1.59^{-1}	1.09^{-1}	1.35
Nursing ward [1]	1.38	2.11	3.23	1.33	2.02	3.07	1.17^{-1}	1.31	2.01	1.27^{-1}	1.21	1.86
II. neoplasma				1.09	1.70	2.66	1.01^{-1}	1.54	2.41	1.01^{-1}	1.54	2.41
III. endocrinological disorders				1.16^{-1}	1.19	1.64	1.19^{-1}	1.16	1.60	1.27^{-1}	1.09	1.52
VII. cardiovascular system				1.41^{-1}	1.11	1.73	1.80^{-1}	1.13^{-1}	1.40	1.83^{-1}	1.15^{-1}	1.38
IX. digestive system				1.16^{-1}	1.18	1.62	1.18^{-1}	1.16	1.59	1.17^{-1}	1.17	1.60
X. urinary tract and sexual organ				1.31^{-1}	1.09	1.55	1.28^{-1}	1.12	1.60	1.29^{-1}	1.11	1.59
XII. skin				2.84^{-1}	1.71^{-1}	1.03^{-1}	2.66^{-1}	1.58^{-1}	1.06	2.65^{-1}	1.58^{-1}	1.06
XIII. skeleton/muscle				1.07	1.51	4.14	1.01	1.43	2.05	1.01	1.44	2.07
XIV. congenital anomalies				1.08	2.53	5.94	1.14	2.70	6.37	1.23	2.91	6.89
In need of care physically							1.07	1.63	2.49	1.02	1.56	2.39
In need of care mentally							1.28	2.39	4.47	1.06^{-1}	1.87	3.71
In need of care physically and mentally							2.44	3.69	5.58	1.90	3.01	4.78
Dementia										1.05^{-1}	1.37	1.97
Depression										1.06^{-1}	1.32	1.83
Other mental disorders										1.39^{-1}	1.09	1.66
Subjects	346			346			346			346		
Events	194			194			194			194		
–2 LL (model 0)	1693.918			1693.918			1693.918			1693.918		
–2 LL	1656.723			1634.663			1594.626			1588.747		
L-Ratio gg. model 0	37.195			59.255			99.292			105.171		
df	3			11			14			17		
p	0.000			0.000			0.000			0.000		
L-Ratio vs prior model	37.195			22.060			40.037			5.879		
df	3			8			3			3		
p	0.000			0.0048			0.000			0.1177		

Relative risk corresponds to exp (B) of the fitting model because of Cox regression and 95% confidence-interval
–2 LL (model 0): –2 Log likelihood of model-0, –2 LL: –2 Log likelihood of given model
L-Ratio: changing of likelihood ratio in comparison to 0-model, df grade of scope, p probability of error, [1] variable dependent of time

now a significant effect on mortality. The tendency was seen that depression increased mortality. The inclusion of mental disorders did not change the effect of the other variables.

Discussion

In a time interval of four years and eight months 58% of the interviewees aged 85 years and older living in the community were dead. 59.5% of the subjects who had refused to participate in the investigation had died. The difference was not significant. Analysing the influence of sociodemographic factors on mortality by using Cox regression, age showed a significant influence on mortality. We found no significant difference according to gender. But a minor part of men in the whole sample demonstrated the higher mortality of men in younger years. In comparison with studies dealing with younger persons widowhood showed no influence on mortality. Most of our subjects had already been widowed years before. Considering living situation mortality was higher for subjects living in institutions.

The lower class showed higher mortality whereby we have to emphasize the methodological problem that we did not have the social class data for all subjects. In Fredman's study (1989) the two-year mortality risk was assessed in 1,606 elderly community participants aged 60 years and older. In comparison with our study the sample size was bigger and the interviewees younger. Age, sex and socioeconomic status were returned as significant sociodemographic co-variables in most of their mortality analysis. In Fredman's study the mortality risk was higher for males and for respondents who were unmarried, contradictory to our study, and comparable to our results the mortality risk was high for subjects who were older, low educated, with chronic disease and who reported their general health as poor. In Singer's (1976) Midtown Manhattan Study six sociodemographic factors were related to mortality: age, male gender, unmarried, less education,

lower income, lower socioeconomic status partly in accordance with and partly contradictory to our results. Some community surveys demonstrated that marriage, social networks and household composition reduced the risk of mortality for sub-groups in the population (Berkman and Syme 1979, Egolf 1992). The probands were younger than those in our study. Perhaps in older age marriage is more often a burden because of need for care of husband or spouse. The sociodemographic predictors of mortality in the great ECA-project were age, sex, low household income, differences in the distribution of resources (Wilkinson 1992) partly confirming our results.

Depressive and demented probands of our study had a higher mortality. The mortality risk was higher for dementia than depression and for men compared to women for both mental illnesses. The mortality risk for dementia considering the gender is different in different studies. One study imported a higher risk for women (Fichter et al. 1995a), two studies a higher risk for men (Persson 1981, Magnusson 1989) and one study (Rorsman et al. 1986) showed different results in different time intervals. In Jorms (1991) community study of 274 persons aged 70 years and older the probability of death was increased in those diagnosed having a dementia or a depressive disorder as in our study. Five-year mortality in DSM-III-R dementia cases gave a relative risk of 2.42. For DSM-III major depression five-year mortality, showed a relative risk of 1.53. The various criteria for depression are, thus, rather similar in their ability to predict mortality but are weaker predictors than the dementia criteria confirming our results. Jagger (1988) found significantly lower survival rates for people living in the community aged 75 years and older of high degrees of cognitive impairment.

Gurland et al. (1983) reported in a representative community study in New York decreasing mortality risk for demented probands with increasing age. Perhaps the course of dementia is less fulminant in the very elderly than in people of a younger age.

We found a protective effect for obsessive syndromes of low degree. Obsessive syndromes fulfilling the definition of caseness, increased mortality risk comparable to Riegel's (1967) results with an excess mortality in association with rigidity. Bruce and Leaf (1989) and Kouzis et al. (1995) found greater odds of dying for individuals with affective disorders in the ECA-study. For affective disorders the mortality-risk is higher for men (Murphy 1987, Murphy et al. 1988, Davidson et al. 1988, Persson 1981, Magnusson 1989, Bruce 1994). Controlling for the effects of age, sex and physical disorder, survival regressions of the Stirling county study showed that the presence of any type of affective disorder had a significant association with excess mortality but did not significantly interact with age or with sex (Murphy 1987). Maintaining the same controls Murphy (1987) found that depression was significantly associated with increased mortality and that it had a significant interaction with sex. The relationship between depression and death was significantly more pronounced for men than for women. Murphy reflected that some portion of the dominance of women in rates of depression may be due to the fact that men are more likely to die of it while women are more likely to be disabled by it.

Whereas depressed persons had a significantly higher mortality risk than non-depressed persons in four further community studies (Enzell 1984, Markush 1977, Nielsen 1977, Persson 1981, follow-up periods ranged from 3 to 15 years), Fredman (1989) and Singer (1976) on the contrary found no association between depressive symptoms and dying. Harris and Barraclough (1998) combined studies by metaanalysis and found for all affective disorders for all causes of death the risk to be 1.7 times that expected. The growing literature discusses psychiatric conditions such as depression as precursors to disease, also the biological pathways are not yet understood. Other evidence is that medical illness and physical limitations can prompt psychiatric reactions. In Fichter's Upper Bavarian follow-up study (1995 a) the more severe mental disorders were categorized at first assessment the more likely was subsequent mortality. Somatic and mental disorders tended to correlate. Persons with mental as well as somatic disorder had the highest excess mortality. Morris (1993) reported that poststroke depressed mood was associated with an increased risk of subsequent mortality.

The subjective estimation of health status including physical and mental status revealed a close association with mortality in our study. The objective estimation of need for care resulted in a positive correlation as well. The increasing frequency of consultations with the general practitioner during the last 12 months increased the risk of dying. In Singer's (1976) Midtown Manhattan restudy self-rated health status proved to be the most powerful predictor of mortality. It is possible that the self-rated health measure is in some sense indicating mental health or a combination of physical and psychological well-being, which is a more powerful predictor of the likelihood of dying than either the mental health rating or the index of physical health alone. Need for care and subjectively estimated bad health status were additionally identified as risk factors for depression (Meller et al. 1997). In Jagger's (1988) study two interesting results merged for perceived health status. For people who considered themselves as being in poor health the risk of death was over three times higher than for those judging themselves of good health. Even adjusting for age, sex, functional capacity, cognitive impairment, drug use and living alone, Jagger's study demonstrated that those of poor opinion of their health suffered from doubled death rate.

Considering several variables by multi-variate analysis, results are sometimes changed, reducing or enhancing the effect of the single variables.

Our multi-variate Cox regression analysis demonstrated higher mortality by increasing age and need for care. A large part of the effect of institutional living situation on mortality was put down to need for care. Mental disorders showed an influence, but less than expected. Their effect was reduced by other variables of the multivariate Cox regression analysis in comparison with Cox

regression analysis considering only the mental health status.

Pulska (1998) analysed the survival of elderly Finnish people with major depression, living in the community. When age, sex, marital status, level of education, smoking, physical health and major depression were introduced into the Cox-model, the model we also used, advanced age, male sex, smoking, poor physical health and the occurence of major depression were found to be related to higher levels of mortality. These results suggest that the higher mortality of subjects with major depression is not explained by their poorer physical health.

The six-year survival of Finnish people suffering from dysthymic disorders, living in the community changed the results (Pulska et al. 1997). The six-year survival curves showed an increased mortality of the depressed elderly. However, when the simultaneous relationships of age, marital status, education, smoking, functional abilities, somatic illness and depression were taken into account, depression did not predict mortality - comparable to our study demonstrating less influence on mortality by mental disorders in the multi-variate Cox model.

In Jorm's study (1991) age, ADL-score, MMSE-score and dysphoric mood were determined as predictors of mortality. Although dysphoric mood made a significant contribution when entered alone, its effect disappeared when either age or ADL-score was entered simultaneously. However, dysphoric mood continued to have an independent effect when entered simultaneously with the MMSE-score. In Jorm's study depressive disorder appeared to predict mortality only because of its correlation with physical illness. Among those who died, depression cases tended to die sooner indicating an association with terminal illness, and the predictive effect of depression disappeared once the effect of physical illness was taken into account.

Singer et al. (1976), discussing the results of the Midtown Manhattan study, advanced the argument that mental disorders alone did not contribute to the apparent excess mortality in persons with mental disorders, but other concomitant factors such as age or somatic comorbidity. Singer noted that the effect of mental health on mortality net of age, marital status, socioeconomic status, sex, self-rated health and the summary health index is negligible. In Bruce's analysis (1994) the risk of dying associated with cognitive impairment is reduced considerably from 2.5 to 1.43, once sex, age and physical health status are controlled. In our study in the multi-variate Cox regression analysis considering different factors like sociodemographic factors, somatic illness, need for care and mental disorder, the influence of mental disorder on mortality was reduced and the factor need for care, necessary because of somatic or mental illness or a combination of both, showed the greatest influence.

The comparison of different community mortality studies is difficult and some methodological problems have to be discussed. In one example there are only small numbers of persons with psychiatric disorders. The diagnostic procedures are different, in some studies self-rating scales, in other studies different diagnostic assessments are used. The diagnosis alone is not sufficient to define the mortality risk. Other relevant risk factors like demographic characteristics, type of aftercare or physical morbidity have to be considered. Different models showed different risk-factors. Part of the different results in mortality studies is due to different methodological ways. A reference group to mortality is different in different studies. Sometimes mortality of depressives is compared with the mortality in the general population, sometimes with that of non depressives and sometimes with that of the mentally healthy. The significance is dependent on sample size, too. The opinion about the importance of lengths of examination interval is discrepant.

If depression is associated with terminal illness, the correlation of depression with mortality will be most evident in shorter follow-ups. If the follow-up period is lengthened, the effects of depression associated with terminal illness will tend to become weaker (cited to from Jorm 1991).

Finally, some shortcomings of our study deserve mentioning. A much larger sample would have been desirable. The categorization of social class was not available for all probands. The question also remains open of how the presence of a physical illness at the time of assessment affects the health course over the following years. To what extent is the effect of an increased mortality risk in the mentally ill with somatic illness independent of the mental illness? Do mental and somatic illness interact to increase the mortality risk? It is necessary to learn more about the process by which psychiatric and physical health factors interact to affect mortal risk.

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References

American Psychiatric Association (1980) Diagnostic statistical manual of mental disorders, third edition. American Psychiatric Association, Washington DC

Berkman LF, Syme SL (1979) Social networks, host resistance, and mortality: a nine-year follow-up study of Alameda County residents. Am J Epidemiol 109 : 186–204

Blossfeld H, Hamerle A, Meyer KU (1986) Ereignisanalyse. Statistische Theorie und Anwendung in den Wirtschafts- und Sozialwissenschaften. Frankfurt, New York

Bruce ML, Leaf PJ (1989) Psychiatric disorders and 15-month mortality in a community sample of older adults. Am J Public Health 79 : 727–730

Bruce ML, Leaf PJ, Rozal GPM, Florio L, Hoff RA (1994) Psychiatric status and 9-year mortality in the New Haven Epidemiologic Catchment Area study. Am J Psychiatry 151 : 716–721

Copeland JRM, Dewey ME, Griffiths-Jones HM (1986) A computerized psychiatric diagnostic system and case nomenclature for elderly subjects. GMS and AGECAT. Psychological Medicine 16 : 89–99

Copeland JRM, Gurland BJ, Dewey ME, Kelleher MJ, Smith AMR, Davidson JA (1987) Is there more dementia, depression and neurosis in New York? A comparative study of the elderly in New York and London using the computer diagnosis AGECAT. British Journal of Psychiatry 151 : 466–473

Davidson IA, Dewey M, Copeland JRM (1988) The relationship between mortality and mental disorder: evidence from the Liverpool longitudinal study. International Journal of Geriatric Psychiatry 3 : 95–98

Egolf B, Lasker J, Wolf S, Potvin L (1992) The roseto effect: a 50-year comparison of mortality rates. Am J Public Health 82 : 1989–1992

Enzell K (1984) Mortality among persons with depressive symptoms and among responders and nonresponders in a health check-up. Acta Psychiatr Scand 69 : 89–102

Farr W (1841) Report upon the mortality of lunatics. Journal of Statistics in Sociology 4 : 17–33.

Fichter MM, Rehm J, Elton M, Dilling H, Achatz F (1995 a) Mortality risk and mental disorders: longitudinal results from the Upper Bavarian Study. Psychological Medicine 25 : 297–307

Fichter MM, Meller H, Schröppel H, Steinkirchner R (1995 b) Dementia and cognitive impairment in the oldest old in the community. Prevalence and comorbidity. British Journal of Psychiatry 166 : 621–629

Fredman L, Schoenbach VJ, Kaplan BH, Blazer DG, James SA, Kleinbaum DG, Yankakas B (1989) The association between depressive symptoms and mortality among older participants in the Epidemiologic Catchment Area-Piedmont Health Survey. J Gerontol Soc Sci 44 : 149–156

Goldberg E, Comstock GW, Hornstra RK (1979) Depressed mood and subsequent physical illness. Am J Psychiatry 136 : 530–534

Gurland B, Copeland J, Kuriansky J, Kelleher M, Sharpe L, Dean L (1983) The mind and mood of aging. Croom Helm London

Hamilton M (1976) 049 HAMD Hamilton Depression Scale. In: Guy W ECDEU assessment manual for psychopharmacology. Maryland, rev. ed. Rockville 179–192

Harris EC, Barraclough BM (1994) Suicide as an outcome for medical disorders. Medicine 73 : 281–296

ICD-9 (1980) Diagnosenschlüssel und Glossar psychiatrischer Krankheiten. Springer Verlag, Berlin Heidelberg New York

ICD-10 (1991) Internationale Klassifikation psychischer Störungen. Dilling H, Mombour W, Schmidt MH (Hrsg.). Verlag Hans Huber, Bern Göttingen Toronto

Jagger C, Clarke M (1988) Mortality risks in the elderly: five-year follow-up of a total population. International Journal of Epidemiology 17 : 111–114

Jorm AF, Henderson AAS, Kay DWK, Jacomb PA (1991) Mortality in relation to dementia, depression and social integration in an elderly community sample. International Journal of Geriatric Psychiatry, 6 : 5–11

Kendler KS (1986) A twin study of mortality in schizophrenia and neurosis. Arch Gen Psychiatry 43 : 643–649

Kouzis A, Eaton WW, Leaf PJ (1995) Psychopathology and mortality in the general population. Soc Psychiatry Psychiatr Epidemiol 30 : 165–170

Madianos MG, Economou M, Stefanis CN (1998) Long-term outcome of psychiatric disorders in the community: a 13-year follow-up-study in a nonclinical population. Comprehensive Psychiatry (Vol. 39, No. 2) : 47–56

Magnusson H (1989) Mental health of octogenerians in Iceland. An epidemiological study. Acta Psychiatr Scand 349, Vol. 79

Markush RE, Schwab JJ, Farris P, Present PA, Holzner CE (1977) Mortality and community health, the Atlanta County, Florida, Mortality Study. Archives of General Psychiatry 34 : 1393–1401

Meller I, Fichter MM, Schröppel H (1996) Incidence of depression in octo- and nonagenerians: results of an epidemiological follow-up community study. Eur Arch Psychiatry Clin Neurosci 246 : 93–99

Meller I, Fichter MM, Schröppel H (1997) Risk factors and psychosocial consequences in depression of octo- and nonagenerians: results of an epidemiological study. Eur Arch Psychiatry Clin Neurosci 247 : 278–287

Moore H, Kleining G (1960) Das soziale Selbstbild der Gesellschaftsschichten in Deutschland. Kölner Zeitschrift für Soziologie und Sozialpsychologie 12 : 86–119

Morris LP, Robinson RG, Andrzejewski P, Samuels J, Price TR (1993) Association of depression with 10-year poststroke mortality. American Journal of Psychiatry 150 : 124–129

Murphy JM, Monson RR, Olivier DC, Sobol AM, Leighton AH (1987) Affective disorders and mortality: a general population study. Arch Gen Psychiatry 44 : 473–480

Murphy E, Smith R, Lindesay J, Slattery J (1988) Increased mortality rates in late-life depression. Br J Psychiatry 152

Nielsen J, Homma A, Biorn-Henriksen T (1977) Follow-up 15 years after a gerontopsychiatric prevalence study. Conditions concerning death, cause of death and life expectancy in relation to psychiatric diagnosis. J Gerontol 32 : 554–561

Ödegard O (1952) Excess mortality of the insane. Acta Psychiatrica and Neurologica 27 : 353–367

Persson G (1981) Five-year mortality in a 70-year-old urban population in relation to psychiatric diagnosis, personality, sexuality and early parental death. Acta Psychiat Scand 64 : 244–253

Pulska T, Pahkala K, Laippala P, Kivela SL (1997) Six-year survival of depressed elderly Finns: a community study. International Journal of Geriatric Psychiatry 12 : 942–950

Pulska T, Pahkala K, Laippala P, Kivela SL (1998) Major depression as a predictor of premature deaths in elderly people in Finland: a community study. Acta Psychiatr Scand 97 : 408–411

Riegel KF, Riegel RM, Meyer G (1967) Socio-psychological factors of aging: a cohort-sequential analysis. Hum Develop 10 : 27–56

Rorsman B (1974) Mortality among psychiatric patients. Acta Psychiat Scand 50 : 354–375

Rorsman B, Hagnell O, Lauke J (1986) Psychiatric mortality in the Lundby Study: an overview. Acta Psychiatr Belg 86 : 510–511

Singer E, Garfinkel R, Cohen SM, Srole L (1976) Mortality and mental health: evidence from the Midtown Manhattan Restudy. Social Sciences and Medicine 10 : 517–525

Tsuang MT, Simpson JC (1985) Mortality studies in psychiatry. Should they stop or proceed? Archives of General Psychiatry 42 : 98–103

Weissman MM, Myers JK, Thomson WD, Belanger A (1986) Depressive symptoms as a risk factor for mortality and for major depression. In: Erlanmeyer-Kimling L, Miller NE (eds) Life span research on the prediction of psychopathology. Erlbaum, Hillsdale, N.J. pp 251–260

Wilkinson RG (1992) Strong differences between income distribution within the society continue to determine national mortality. Am J Public Health 82 : 1082–1084

Zaudig M, Mittelhammer J, Hiller W (1990) SIDAM - Strukturiertes Interview für die Diagnose der Demenz vom Alzheimer-Typ, der Multiinfarkt-Demenz und Demenzen anderer Ätiologie nach DSM-III-R und ICD-10 Manual. LOGOMED Verlag München

Zaudig M, Mittelhammer J, Hiller W et al. (1991) SIDAM – A structured interview for the diagnosis of dementia of the Alzheimer type, multi-infarct dementia and dementias of other aetiology according to ICD-10. Psychological Medicine 21 : 225–236