Psychological Medicine, 1995, **25**, 297–307.

Mortality risk and mental disorders: longitudinal results from the Upper Bavarian Study

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SYNOPSIS The object of the study was the assessment of the mortality risk for persons with a mental disorder in an unselected representative community sample assessed longitudinally. Subjects from a rural area in Upper Bavaria (Germany) participated in semi-structured interviews conducted by research physicians in the 1970s (first assessment) and death-certificate diagnoses were obtained after an interval up to 13 years later. The sample consisted of 1668 community residents aged 15 years and over.

Cox regression estimates resulted in an odds ratio of 1·35 (confidence interval 1·01 to 1·81) for persons with a mental disorder classified as marked to very severe. The odds ratio increased with increasing severity of mental illness from 1·04 for mild disorders, 1·30 for marked disorders, to 1·64 for severe or very severe disorders. The relative risk (odds ratio) for persons with a mental disorder only and no somatic disorder was 1·22, for persons with only a somatic disorder 2·00, and for those with both a mental and a somatic disorder 2·13. The presence of somatic illness was responsible for most of the excess mortality. Somatic disorders associated with excess mortality in mental disorders were diseases of the nervous system or sensory organs, diseases of the circulatory system, diseases of the gastrointestinal tract, and diseases of the skeleton, muscles and connective tissue (ICD-8).

Thus, while mental illness alone had a limited effect on excess mortality, comorbidity with certain somatic disorders had a significant effect.

INTRODUCTION

Since Farr's report in 1841 on mortality among 'lunatics' in British asylums and Ødegard's study of excess mortality among the insane in Norway (Ødegard, 1952), increased mortality in the mentally ill has been confirmed repeatedly. Most studies have dealt with psychiatrically treated patients (Babigian *et al.* 1969; Kerr *et al.* 1969; Rorsman, 1974; Black *et al.* 1985; Martin *et al.* 1985 and others), especially patients treated for dementia (Jagger & Clarke, 1988; Jorm *et al.* 1991) and patients treated for alcohol abuse or dependency have shown excess mortality (Berglund, 1984; Martin *et al.* 1985). The issue of excess mortality in patients with a psychiatric disorder has been reviewed by Tsuang & Simpson (1985) and in Öhman *et al.* (1989).

However, as the majority of persons with mental disorder do not come to the attention of mental health specialists (Shapiro *et al.* 1984), data derived from treated patients is not representative for a community because of selection factors. The few studies undertaken on representative community samples have generally confirmed an increased mortality rate in persons who had previously shown signs of mental illness. Rorsman *et al.* (1982) reported from the Lundby study in Sweden a relative death rate from natural causes (death rate in mentally ill/death rate in standard population) of 1·5 among men and 1·2 among women with a background of mental disorder; they found no excess mortality among neurotics. Murphy *et al.* (1989) from the Stirling County Study found that persons with mental disorder at first

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assessment experienced 1·6 times the expected number of deaths; alcoholism, depression, organic brain disorders and other psychoses, and personality disorder (including mental retardation) were associated with significantly increased mortality ratio, while anxiety disorders, somatization and neurotic disorders were not associated with excess mortality.

Tsuang & Simpson (1985) have pointed to the importance of mortality studies in psychiatry, since the analysis of risk factors for mortality can be of help in monitoring new risk groups, drawing conclusions about clinical care and aftercare, and designing programmes for the prevention of premature death. While risk-factor intervention trials have been conducted in connection with other medical conditions such as coronary heart disease (The Multiple Risk Factor Intervention Trial Research Group, 1990), the state of the art in psychiatry with regard to risk factors is still descriptive and analytical. In the present study the mortality risk of persons with psychiatric disorders in a community sample was analysed 13 years after first psychiatric assessment.

METHOD

The first wave of the Upper Bavarian Study was conducted between 1975 and 1977 (Dilling *et al.* 1984). The sample consisted of 1668 community residents aged $\geqslant 15$ years. It was drawn randomly from the community registers of two towns, Traunstein and Traunreut, and the village of Palling, in Upper Bavaria. In a second wave of assessment from 1980 to 1986 the same sample was re-interviewed by psychiatrically trained physicians (see Fichter, 1990). The Upper Bavarian Study was concerned with the assessment of prevalence and incidence of mental disorders in the general population, and with the analysis of factors affecting the course of illness (see Dilling & Weyener, 1984; Fichter *et al.* 1989).

In the first wave, 1536 persons (92·1% of the sample) were interviewed. Since all those interviewed were to be categorized for mental and somatic disorders, according to ICD 8 (World Health Organization, 1974), only psychiatrically trained physicians could serve as interviewers. Besides disease category, the following index of severity was used (Dilling & Weyener, 1984; Fichter & Witzke, 1990): 0, no mental symptoms; 1, mild mental disturbance or isolated symptom that usually does not require medical treatment; 2, marked mental disorder usually requiring treatment from a general practitioner; 3, severe mental disorder usually requiring referral to a psychiatrist or psychotherapist, or to a specialized treatment facility; and 4, very severe mental disorder usually requiring intensive psychiatric treatment (inpatient treatment at a psychiatric hospital or a comparable treatment facility). A similar severity index was used for somatic disorders.

In addition, the interviewers administered a standardized psychiatric interview developed by Goldberg *et al.* (1970) and recorded sociodemographic variables, use of psychiatric and other medical facilities, health complaints, and lifestyle variables.

Thirteen years later another assessment was performed, to determine the number of deaths that had occurred in the sample. In addition, the exact date of death, the disease or condition directly leading to death, and antecedent illnesses were recorded from the death certificates, according to ICD-9 (Bundesminister für Jugend, Familie und Gesundheit, 1979). Since data on suicide as a possible cause of death must be considered as unreliable and incomplete on the basis of the official death certificate in Germany, this issue was not analysed. For 1430 (93·1%) of the 1536 people interviewed in the first wave, it was possible to obtain information on vital status. This represented 85·7% of the original sample, and thus gives a good basis for generalization from the study findings. The remaining 106 people had in the meantime moved to other places in Germany and therefore we could not get the official information on their vital status. Their psychiatric morbidity at the first wave of assessment did not differ from the total sample; there is no evidence that the exclusion due to missing data had an effect on our results.

RESULTS

The results are presented in four parts: the prevalence of different mental disorders by sex and age; an overview of mortality rates in the Upper-Bavarian sample, by sex and age; the relationship between mental disorders and mor-

Table 1. *Prevalence of selected mental disorders*

Age category	Females				Males				Total			
	⩽ 29 (*N* = 182)	30–44 (*N* = 179)	45–59 (*N* = 190)	⩾ 60 (*N* = 227)	⩽ 29 (*N* = 171)	30–44 (*N* = 191)	45–59 (*N* = 138)	⩾ 60 (*N* = 152)	⩽ 29 (*N* = 353)	30–44 (*N* = 370)	45–59 (*N* = 328)	⩾ 60 (*N* = 379)
	N (%)	*N* (%)	*N* (%)	*N* (%)	*N* (%)	*N* (%)	*N* (%)	*N* (%)	*N* (%)	*N* (%)	*N* (%)	*N* (%)
Mental disorder (ICD8)												
Organic and other mental brain disorders (290.0–294.9, 309.0–309.9)	0 (0)	1 (0·6)	2 (1·1)	29 (12·8)	1 (0·6)	4 (2·1)	2 (1·4)	25 (16·4)	1 (0·3)	5 (1·4)	4 (1·2)	54 (14·2)
Other psychosis (295.0–299.9)	1 (0·5)	3 (1·7)	7 (3·7)	15 (6·6)	1 (0·6)	1 (0·5)	0 (0)	3 (2·0)	2 (0·6)	4 (1·1)	7 (2·1)	18 (4·7)
Neurosis (300.0–300.9)	37 (20·3)	56 (31·3)	71 (37·4)	45 (19·8)	16 (9·4)	29 (15·2)	37 (26·8)	15 (9·9)	53 (15·0)	85 (23·0)	108 (32·9)	60 (15·8)
Personality disorders (301.0–301.9)	2 (1·1)	10 (5·6)	5 (2·6)	11 (4·8)	5 (2·9)	9 (4·7)	4 (2·9)	6 (3·9)	7 (2·0)	19 (5·1)	9 (2·7)	17 (4·5)
Psychosomatic disorders (305.0–305.9)	19 (10·4)	14 (7·8)	11 (5·8)	3 (1·3)	3 (1·8)	23 (12·0)	15 (10·9)	4 (2·6)	22 (6·2)	37 (10·0)	26 (7·9)	7 (1·8)
Alcohol-related disorders (303.0–303.9)	0 (0)	0 (0)	1 (0·5)	0 (0)	15 (8·8)	14 (7·3)	18 (13·0)	12 (7·9)	15 (4·2)	14 (3·8)	19 (5·8)	12 (3·2)
Oligophrenia (310.0–315.9)	2 (1·1)	2 (1·1)	2 (1·1)	1 (0·4)	7 (4·1)	2 (1·0)	1 (0·7)	2 (1·3)	9 (2·5)	4 (1·1)	3 (0·9)	3 (0·8)
At least one psychiatric diagnosis	51 (28·0)	80 (44·7)	91 (47·9)	99 (43·9)	45 (26·3)	59 (30·9)	62 (44·9)	57 (37·5)	96 (27·2)	139 (37·6)	153 (46·6)	156 (41·2)
One psychiatric diagnosis	40 (22·0)	73 (40·8)	81 (42·6)	83 (36·6)	38 (22·2)	44 (23·0)	42 (30·4)	45 (29·6)	78 (22·1)	117 (31·6)	123 (37·5)	128 (33·8)
Two psychiatric diagnoses	11 (6·0)	7 (3·9)	10 (5·3)	16 (7·0)	7 (4·1)	15 (7·9)	20 (14·5)	12 (7·9)	18 (5·1)	22 (5·9)	30 (9·1)	28 (7·4)
Psychiatric diagnosis with maximum severity = 1 (mild)	28 (15·4)	49 (27·4)	37 (19·5)	40 (17·6)	29 (17·0)	36 (18·8)	34 (24·6)	26 (17·1)	57 (16·1)	85 (23·0)	71 (21·6)	66 (17·4)
Psychiatric diagnosis with maximum severity 2–4 (marked–very severe)	23 (12·6)	31 (17·3)	54 (28·4)	59 (25·9)	16 (9·3)	23 (12·1)	28 (20·2)	31 (20·4)	39 (11·1)	54 (14·6)	84 (25·0)	90 (23·8)

Table 2. *Number of deaths by age group*

Age (years)	Total sample ($N = 1430$) N/N_{total}*	%	Females ($N = 778$) N/N_{total}*	%	Males ($N = 652$) N/N_{total}*	%
⩽ 29	2/353	0·57	0/182	0	2/171	1·17
30–44	10/370	2·70	7/179	3·91	3/191	1·57
45–59	36/328	10·98	9/190	4·74	27/138	19·57
⩾ 60	178/379	46·97	102/227	44·93	76/152	50·00
Age-restricted sample 30–69	117/908	12·89	53/489	10·63	65/419	15·51
Total sample	226/1430	15·80	118/778	15·17	108/652	16·56

* N denotes the number of deaths; N_{total} the number of persons in the sample.

Table 3. *Mental disorders and mortality I – Data base and Mantel–Haenszel estimates*

	Females	Males	Total*
Number of deaths per psychiatric categories 7-day prevalence, severity			
1 (mild)	20 (8)	21 (9)	41 (17)
2 (marked)	30 (16)	20 (14)	50 (30)
3/4 (severe/very severe)	8 (2)	8 (5)	16 (7)
2–4	38 (18)	26 (19)	66 (37)
1–4	58 (26)	49 (28)	107 (54)

	Females Odds ratio			Males Odds ratio			Total* Odds ratio		
	Lower†		Upper†	Lower		Upper	Lower		Upper
Mantel–Haenszel estimates stratified for age* 7-day prevalence, severity									
1–4 *v.* 0	0·88	1·41	2·26	0·92	1·53	2·52	1·04	1·46	2·06
2–4 *v.* 0–1	1·00	1·71	3·03	0·90	1·71	3·30	1·15	1·71	2·62

* Prior to Mantel–Haenszel analyses all tests of whether odds ratios differed across age strata proved to be non-significant at the 5% level. There were no significant differences on the same level regarding sex.
† 95% confidence interval limits.
Numbers in parentheses refer to the age-restricted sample (30 to 69 years old).

tality; and the role of somatic disorders in the excess mortality of mental disorders.

Prevalence of mental disorders

An overview of the 7-day point-prevalence rate of mental disorders, including all levels of severity, stratified by sex and age, as assessed by the interviewers is shown in Table 1. Clearly, neuroses are the most prevalent mental disorders in the general population, followed by psychosomatic disorders. As expected, organic and other mental brain disorders affect predominantly the oldest age group (60 years and over), constituting the most prevalent mental disorder for males and the second most prevalent for females. Notable also is the marked sex difference in the prevalence of alcohol-related disorders.

The second part of Table 1 shows an overview of multiple diagnoses and severity of diagnosis. Severity category one (mild disturbances usually requiring no medical treatment) was by far the

Table 4. *Mental disorders and mortality II – Logistic and Cox regression analyses*

	Females Odds ratio*			Males Odds ratio*			Total Odds ratio*		
	Lower†		Upper†	Lower		Upper	Lower		Upper
Logistic regression estimates									
7-day prevalence, severity									
1–4	0·79	1·29	2·10	0·87	1·46	2·45	0·95	1·36	1·94
	(0·64	1·18	2·17)	(0·80	1·45	2·64)	(0·86	1·31	2·01)
2–4	0·89	1·53	2·64	1·06	1·96	3·65	1·13	1·69	2·54
	(0·80	1·53	2·95)	(1·29	2·59	5·20)	(1·22	1·95	3·14)
7-day prevalence									
per diagnosis	0·95	1·40	2·06	0·86	1·24	1·81	1·01	1·32	1·72
(one/two)	(0·81	1·31	2·12)	(0·82	1·24	1·87)	(0·92	1·27	1·73)
7-day prevalence, severity									
1 (mild)	0·51	0·99	1·93	0·54	1·07	2·08	0·64	1·02	1·64
	(0·35	0·83	1·97)	(0·34	0·78	1·82)	(0·44	0·81	1·48)
2 (marked)	0·81	1·49	2·74	0·81	1·64	3·33	0·97	1·54	2·43
	(0·73	1·49	3·04)	(0·88	1·96	4·32)	(1·00	1·70	2·88)
3/4 (severe/very severe)	0·55	1·72	5·34	1·25	4·17	13·96	1·14	2·65	6·13
	(0·23	1·24	6·60)	(1·55	5·64	20·52)	(1·09	2·94	7·94)
Cox regression estimates									
7-day prevalence, severity									
1–4	0·82	1·18	1·70	0·92	1·35	1·99	0·93	1·22	1·58
	(0·66	1·14	1·97)	(0·88	1·45	2·39)	(0·91	1·32	1·91)
2–4	0·89	1·32	1·96	0·93	1·45	2·24	1·01	1·35	1·81
	(0·81	1·43	2·54)	(1·24	2·12	3·64)	(1·20	1·78	2·64)
7-day prevalence									
per diagnosis	0·97	1·31	1·75	0·93	1·24	1·64	1·01	1·24	1·53
(one/two)	(0·83	1·28	1·97)	(0·90	1·26	1·77)	(0·98	1·27	1·66)
7-day prevalence, severity									
1 (mild)	0·59	0·98	1·63	0·72	1·19	1·98	0·73	1·04	1·49
	(0·38	0·84	1·85)	(0·43	0·90	1·89)	(0·51	0·88	1·50)
2 (marked)	0·84	1·31	2·03	0·81	1·35	2·25	0·93	1·30	1·81
	(0·75	1·40	2·61)	(0·93	1·74	3·23)	(1·02	1·59	2·47)
3/4 (severe/very severe)	0·63	1·38	3·04	1·05	2·29	5·01	0·95	1·64	2·85
	(0·28	1·16	4·91)	(1·71	4·53	12·01)	(1·38	2·96	6·39)

* All odds ratios refer to regression analyses with adjustment for age (females, males, total) and for sex (total). The comparison group consisted of persons with no mental disorder in the 7-day interval (severity = 0 with the exception of the odds ratios for severity 2–4 where severity 0–1 served as comparison).

† 95% confidence interval limits.

Numbers in parentheses refer to the age-restricted sample (30 to 69 years old).

most prevalent. For females under 45 and for males under 60 years of age, it even exceeded the other severity categories 2–4 together.

Mental disorders and mortality

As shown in Table 2, mortality increased with age and was higher for males than for females. Our results support the hypothesis of an excess mortality for persons with mental disorders when certain additional variables of importance are excluded (Tables 3 and 4).

Three kinds of analysis were performed. Mantel–Haenszel analyses showed overall significant effects, with relative risks of 1·46 (confidence interval: 1·04–2·06) for all persons with mental disorder, and 1·71 (confidence interval: 1·15–2·62) for persons with mental disorder requiring medical treatment.

Mantel–Haenszel analyses were performed for all persons aged $\geqslant 29$ years, since only two people below that age had died in the interval (Table 3). Bases were 2×2 tables (mental disorder absent/present, by dead/alive) for three different age strata and both sexes, which were pooled by the Mantel–Haenszel estimator. This procedure can be considered as a weighted averaging of the stratum-specific estimates (Mantel & Haenszel, 1959). The program EPI5 was used, with the calculation of exact confidence intervals (Mehta *et al.* 1985).

Whereas the combined results for both sexes together were significant, the separate analyses showed similar effect sizes (Rosenthal & Rosnow, 1984) but were significant only for women and mental disorders in severity categories 2–4. This result is largely due to the halved sample sizes.

Logistic regression adjusted for age[1] yielded very comparable results to those of the table analyses (Table 4). All analyses were performed for the complete sample as well as for an age-restricted sample (shown in parentheses in Table 4). The age-restricted sample was chosen also to deal with the possible argument that very old people have multiple morbidity, complicating the question of diagnosis. However, the results from the age-restricted sample show that the results are very similar to those from the total sample.

Moreover, there is a dose-response relationship for different degrees of severity of mental disorder. The more severe the mental disorder at first assessment, the more likely it was for death to occur. The inclusion of all severity levels proved to be significant for males, and for males and females combined, in the age-restricted sample ($G = 9{\cdot}35$ males, $P < 0{\cdot}05$; $G = 8{\cdot}89$ males and females combined, $P < 0{\cdot}05$; see Hosmer & Lemeshow (1989) for an explanation of this statistic), and to be marginally significant for the same categories in the total sample ($G = 6{\cdot}36$ males, $P < 0{\cdot}10$; $G = 7{\cdot}75$ both sexes, $P < 0{\cdot}10$).

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 to survive the entire 13-year-period is small. One method of dealing with this problem is to include survival time in the analysis by means of Cox regression. This type of analysis could take into account the effects of the longer survival time of the mentally healthy, even when the overall rate for the 13-year-period is the same.

The lower part of Table 4 shows an overview of the respective results. Although the odds ratios sometimes tend to be a little lower, no different conclusions can be drawn. All effects already statistically significant with logistic regression remained so, and no other associations emerged as statistically significant.

Since all methods used yielded very similar conclusions we applied only one method for all further analyses, this was the Cox regression. This choice was made since it seems to yield most conservative results, and since it takes into account the effects of age best.

Table 5 shows the relative mortality risk for specific groups of mental disorders according to ICD-8: as significantly increased mortality risk was observed only for females with an organic or another mental brain disorder and marginally for females with oligophrenia. A Type II error cannot be excluded here since a breakdown in specific diagnostic groups reduces the number of cases in the 7×2 cells analysed.

The role of somatic diseases

The results largely confirm other findings reported in the literature, but also show a possible cause for the excess mortality of persons with mental disorders. The basis for this was the finding that somatic and mental disorders tended to correlate. The Spearman correlations between the severity of somatic and mental disorders reached 0·25 for the total sample (0·24 for the age-restricted sample), 0·28 for the males (0·31) and 0·21 for the females (0·18). Given the sample sizes, these correlations are highly significant.

To ascertain whether the excess mortality was due to the somatic disorders, the sample was divided into four groups: persons with no disorders ($N = 532$, 273 males and 259 females); persons with somatic disorders only ($N = 354$, 156 males and 198 females); persons with mental disorders only ($N = 206$, 82 males and 124 females); and persons with somatic and mental disorders ($N = 338$, 141 males and 197 females). Table 6 shows the relative risks of death for the three latter groups compared with the group with no disorders. The inclusion of all three terms increased the goodness of fit of all models at least at the 10% level of significance.

It is clear that the presence of somatic illness is responsible for most of the excess mortality. Thus, for neither males, nor females, nor for the total sample, did the relative risk for persons with mental disorders only approach

[1] Age was entered only as another linear term in the equation since prior analyses showed that the additional entering of age as a quadratic term did not significantly improve the goodness-of-fit. As shown in Table 2 this kind of age-adjustment is an over-simplification, since the mortality risk is not increasing in a strictly linear way.

Table 5. *Relative mortality risk for specific mental disorders (ICD-8)*†

	Relative risk		
	Males	Females	Total‡
Organic and other mental brain disorders	1·19 (0·69–2·08) (1·70 (0·72–4·02)) *N* = 17	2·05 (1·25–3·36)* (2·77 (1·16–6·59))* *N* = 23	1·45 (1·01–2·10)* (2·05 (1·11–3·79))* *N* = 40
Other psychosis	*N* too small *N* = 2	*N* too small *N* = 4	*N* too small *N* = 5
Neurosis	1·25 (0·73–2·15) (1·01 (0·51–2·01)) *N* = 16	1·29 (0·85–1·95) (1·54 (0·87–2·72)) *N* = 31	1·25 (0·90–1·74) (1·28 (0·83–1·98)) *N* = 47
Personality disorders	*N* too small *N* = 6	*N* too small *N* = 4	*N* too small *N* = 10
Psychosomatic disorders	*N* too small *N* = 4	*N* too small *N* = 2	*N* too small *N* = 6
Alcohol related disorders	1·19 (0·64–2·24) (1·62 (0·80–3·27)) *N* = 11	*N* too small *N* = 0	1·18 (0·63–2·21) (1·68 (0·84–3·36)) *N* = 11
Oligophrenia	*N* too small *N* = 1	*N* too small *N* = 2	*N* too small *N* = 3

* Significantly elevated mortality risk (5% level).
† Age adjusted, Cox regression analyses. For specification of mental disorder see Table 1.
‡ Cox regression analyses included gender adjustment.
N Number of deaths with the specific psychiatric diagnosis. No analyses are presented if $N \leqslant 10$.

Table 6. *The joint influence of mental and somatic disorders on mortality – age-adjusted Cox regression analyses*

	Females Odds ratio†			Males Odds ratio			Total* Odds ratio		
	Lower‡		Upper‡	Lower		Upper	Lower		Upper
7-day prevalence									
Mental disorders only	0·40	1·15	3·33	0·59	1·42	3·38	0·63	1·22	2·39
	(0·12	0·57	2·77)	(0·44	1·37	4·27)	(0·36	0·92	2·33)
Somatic disorders only	1·06	2·07	4·02	1·09	1·90	3·32	1·31	2·00	3·06
	(0·80	2·06	5·27)	(0·95	1·92	3·89)	(1·12	1·97	3·46)
Mental and somatic disorders	1·14	2·20	4·27	1·23	2·14	3·71	1·39	2·12	3·24
	(0·95	2·37	5·92)	(1·15	2·32	4·66)	(1·37	2·38	4·12)

* Cox regressions for the total sample include a term for sex.
† Odds ratio refer to Cox regressions with adjustment for age.
‡ 95% confidence interval limits.
Numbers in parentheses refer to the age-restricted sample (30 to 69 years old).

significance. Moreover, in the age-restricted sample, the values of the relative risk were below 1 for the total sample as well as for the females. By contrast, the relative risks for people with mental and somatic disorders were significantly elevated for all three groups; their mortality risk was 2·2 times higher than for those people without mental or somatic disorders. The relative risks for persons with somatic disorders only were consistently lower, but also around 2.

In conclusion, co-morbid somatic disorders are mainly responsible for the elevated risk of mortality in mental disorders. Table 7 gives details concerning mortality risk in mentally ill persons with different types of somatic disorder. The following ICD-8 main groups of somatic disorder were associated with excess mortality in persons with mental disturbances (Table 7): (1) diseases of the nervous system or of sensory organs (males); (2) diseases of the circulatory system; (3) diseases of the gastro-intestinal tract; and (4) diseases of the skeleton, muscles and connective tissue (females only). The other groups of somatic disorders listed in Table 7 were

Table 7. *Frequency (number and percentage) of persons with a mental and a somatic ICD-8 diagnosis according to main ICD-8 diagnostic groups*

ICD-8 Main group of diagnoses (ICD No.) at first assessment*	Females ($N = 197$)			Males ($N = 141$)			Total ($N = 338$)		
	N	%	Yes/No† (%)	N	%	Yes/No (%)	N	%	Yes/No (%)
II Neoplasms (ICD 140–239)	4	2·0	No	4	2·8	No	8	2·4	No
III Endocrine, nutritional or metabolic diseases (ICD 240–279)	34	17·3	No	15	10·6	No	49	14·5	No
VI Diseases of the nervous system or of sensory organs (ICD 320–389)	21	10·7	No	18	12·8	Yes (3·0–8·1)	39	11·5	Yes (3·8–7·5)
VII Diseases of the circulatory system (ICD 390–458)	88	44·7	Yes (17·1–28·0)	59	41·8	Yes (11·2–26·5)	147	43·5	Yes (14·2–27·4)
VIII Diseases of the respiratory tract (ICD 460–519)	8	4·1	No	13	9·2	No	21	6·2	No
IX Diseases of the gastrointestinal tract (ICD 520–577)	22	11·2	Yes (3·9–8·1)	31	22·0	Yes (3·3–14·4)	53	15·7	Yes (3·6–10·7)
X Diseases of urinary or sexual organs (ICD 580–629)	20	10·2	No	8	5·7	No	28	8·3	No
XII Diseases in the skin (ICD 680–709)	4	2·0	No	6	4·3	No	10	3·0	No
XIII Diseases of the skeleton, muscles and connective tissue (ICD 710–738)	53	26·9	Yes (9·6–16·8)	27	19·1	No	80	23·7	Yes (9·5–15·1)
XVII Accidents, poisoning etc. (ICD 800–999)	6	3·0	No	5	3·5	No	11	3·3	No

* The following ICD-8 main groups of diagnoses were rare in our sample (total $N < 8$) and are therefore omitted from this Table: I infectious diseases; IV diseases of the blood; XIV congenital malformations; and XVI disorders not otherwise specified.

† Statistical significance of occurrence of the specified somatic illness in persons with a mental disorder (in comparison with persons without such a disorder).

not associated with a significantly increased risk of mortality.

DISCUSSION

A major finding of the present study was an excess mortality of 1·35 (odds ratio) for individuals with marked to very severe mental disorder at first assessment (Cox regression estimates). Fairly similar results (odds ratios of 1·69 and 1·71) were derived on the basis of logistic regressions and Mantel–Haenszel estimates stratified for age. Severe mental disorders had a higher mortality risk than mild mental disorders. These findings are generally in accordance with results of other community studies on mental illness and mortality. Murphy *et al.* (1989) reported for the Canadian Stirling County sample that persons with a mental disorder at the beginning of the study experienced 1·6 times the expected number of deaths. Rorsman *et al.* (1982) reported for the Swedish Lundby study an excess mortality of 1·5 among men and 1·2 among women with a background of mental disorder (natural death). However, Singer *et al.* (1976) found for the Midtown Manhattan sample no association between previous mental status and mortality over a 20-year period. Similarly for the Piedmont Epidemiologic Catchment Area (ECA) programme sample Fredman *et al.* (1989) found no association between depressive symptoms and excess mortality.

A number of studies have addressed the issue of increased mortality risk in older persons with mental disorders. Kay & Bergman (1966) reported an increased mortality risk for persons with organic psychoses and persons with functional mental disorders. Persson (1981) reported an increased mortality risk for males with psychosomatic disorders but not for persons with functional mental disorders or personality disorders. For other diagnoses of mental disorder, the following differing results have been reported.

Organic psychosis

Nielsen (1962) reported excess mortality for persons with organic psychosis. Bickel (1987) reported a marked reduction in life expectancy for persons with functional, as well as organic, mental disorders among elderly people in the community. Jorm *et al.* (1991) reported an increased probability of death in elderly persons

with a diagnosis of dementia or depressive disorder, and no association between mortality and social integration.

Depression

Murphy *et al.* (1989) reported high excess mortality associated with depression for persons in the community. In a treated sample, Lönnqvist & Koskenvuo (1988) confirmed this finding with regard to 'natural' causes of death. Black *et al.* (1985) found excess mortality from 'unnatural' causes among patients of either sex with affective disorder, schizophrenia, alcohol or other drug abuse, and personality disorders, among men with acute schizophrenia or neurosis, and among women with depressive neurosis (Iowa Record-Linkage Study). Levav *et al.* (1988) found that bereaved parents experienced no higher mortality than the general population. Morris *et al.* (1993) reported that depressed mood after stroke was associated with an increased risk of subsequent mortality. In our community study neuroses, personality disorders and psychosomatic disorders according to ICD-8 showed no significant increase in the mortality risk either for males or for females.

Anxiety disorders

Results concerning anxiety disorders are contradictory. While Murphy *et al.* (1989) found a low mortality risk for anxiety disorders in the community, Allgulander & Lavori (1991) reported a high risk of suicide in in-patients with anxiety neuroses without psychiatric comorbidity.

Alcoholism

In a patient sample Berglund (1984) reported that the frequency of liver cirrhosis as a primary cause of death compared with that of general mortality was 4·3 times more in men and 6·0 times more in women. In the Upper Bavarian sample, alcohol intake and cigarette smoking increased mortality, while physical activity and partnership stability were associated with decreased mortality (Rehm *et al.* 1993). Calculations of the relative mortality risks for alcohol-related disorders for males (ICD-8 303.0–.9) show the relative risk of 1·19 (age restricted sample 1·62); this elevation was statistically not significant. For females the number of cases was too low for statistical analysis.

Concerning relative mortality risks our study revealed a significantly elevated mortality risk for females with organic or other mental brain disorders. This is in accordance with other studies cited above, which reported an excess mortality in organic mental disorders.

There are some indications that improvements in health services reduce the risk of mortality for patients with mental disorder (Tsuang & Woolsen, 1977; Craig & Lin, 1981). A major issue in the explanation of excess mortality in persons with mental disorders is the impact of co-morbid somatic disorders. Singer *et al.* (1976) in discussing the results of the Midtown Manhattan Study advanced the argument that mental disorders as such did not contribute to the apparent excess mortality in persons with mental disorders, but other concomitant factors such as age or somatic co-morbidity. Results of our study based on age-adjusted Cox regression analyses show that persons with only a mental (and no somatic) disorder had only a slight increase in excess mortality (odds ratio 1·22) while persons with only a somatic (and no mental) disorder had a high excess mortality (odds ratio 2·00). Persons with a mental as well as a somatic disorder had the highest excess mortality (odds ratio 2·12). Thus, while the risk of mortality was not significantly increased for persons who had a mental but no somatic disorder, the group at highest mortality risk was that with both mental and somatic illness.

As might be expected, not all somatic illnesses were associated with increased mortality risk in persons with mental disorder. A significant increase was observed for diseases of the nervous system or of sensory organs, diseases of the circulatory system, diseases of the gastro-intestinal tract and diseases of the skeleton, muscles and connective tissue. No increased risk was observed for neoplasms, endocrine, nutritional or metabolic diseases, diseases of the respiratory tract, diseases of the urinary or sexual organs and diseases of the skin.

Finally, some shortcomings of our study deserve mentioning. Even though the sample consisted of 1668 persons in the community a much larger sample would have been desirable, especially for an analysis of diagnostic or sociodemographic subgroups. The question also remains open of how the presence of a physical illness at the time of first 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? These questions, at present, remain open.

The results reported here can be of help in identifying persons at high risk of premature mortality in the community and in designing treatment and prevention services.

We thank Dr Chr. Buchborn, Ms T. Eiberger, Dr S. Gomahr, Dr S. Maier-Madignier, Dr I. Meller, Dr A. Morath, Dr S. Weyerer and Dr W. Witt for their assessment in the study, D. Blaschke for his help with statistical analysis, and Dr Gallagher for his editorial assistance. We are indebted to Dr Jane Murphy and her co-workers who gave us very valuable advice and support.

This research was supported by a grant of the German Science Foundation (DFG) (Fi 333/3–2).

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