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RESEARCH ARTICLE

Prevalence of psychiatric disorders in an onset cohort of adults with type 1 diabetes

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Abstract

Background Previous studies indicate a high prevalence of psychiatric disorders in adults with type 1 diabetes mellitus. The aim of our study was to determine if newly diagnosed adults with type 1 diabetes already have an elevated rate of psychiatric disorders at the beginning of their physical illness.

Methods The authors consecutively recruited 313 newly diagnosed, adult inpatients with type 1 diabetes (age 17–40 years) from 12 hospitals. A national, representative population sample of 2046 persons of a similar age range served as the reference group. Psychiatric disorders were measured in both groups using structured interviews that provided diagnoses according to DSM-IV.

Results There was a point prevalence of 12.5% for psychiatric disorders in the sample. The most frequent conditions were anxiety and affective disorders. Subjects with type 1 diabetes demonstrated a rate of major depressive episodes twice that of the reference group (5.8% vs 2.7%, $p < 0.003$; corrected for confounders). Apart from this finding, there was no significantly increased prevalence of psychiatric disorders in the diabetes sample as compared to the general German population.

Conclusion The rate of major depressive episodes in the new onset cohort of type 1 diabetes patients was double that of the population as a whole. However, the hypothesis, that newly diagnosed type 1 diabetes patients have more psychiatric disorders than the general population, was not confirmed.
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Keywords diabetes mellitus; mental disorders; comorbidity; multicenter studies

According to various cross-sectional studies, type 1 diabetes is associated with a high prevalence of psychiatric disorders [1–3]. This finding is of particular importance because of the increasing evidence of a link between psychiatric disorders and poorly controlled diabetes [4–6], the latter representing a medical condition with a well-known increase in the risk of microvascular complications [7]. It has become evident recently that the comorbidity of depression with diabetes, in particular, leads to an increased risk for diabetes-related complications, including heart disease and stroke [8]. According to these results, type 1 diabetes patients with a psychiatric comorbidity represent a high-risk group for later complications of diabetes.

The underlying mechanism and the causality behind the association between psychiatric disorders and type 1 diabetes are still poorly understood [9,10]. Current hypotheses focus mainly on two aspects. First, direct adverse effects of the diabetes lead to psychiatric disorders, especially depression [11].

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Several mechanisms have been discussed in this context, ranging from alterations in the activity of the hypothalamic-pituitary-adrenal (HPA) axis [12,13], to alterations in the norepinephrine and serotonin level [14,15], and to the more recent 'vascular depression' hypothesis [16], which explains the late onset of depressive syndromes by means of cerebrovascular diseases, a possible late complication of diabetes.

Second, psychological factors indirectly related to diabetes may mediate the occurrence of psychiatric disorders. The diabetes can be seen as a critical life event that requires multiple coping efforts. In particular, the psychosocial burdens in the wake of the physical disease may promote psychopathology [17–19]. Other previously discussed factors are poor social support [20] and the finding that self-esteem seems to be lowered in type 1 diabetes patients [21]. This lower self-esteem level could either portend or predispose them to risk for future depression. Even the chronological association – whether the onset of psychiatric disorders is preceded by diabetes or vice versa – remains unclear for patients with type 1 diabetes [9,22,23]. (Regarding patients with type 2 diabetes, there is evidence from prospective studies that such patients have an increased risk of developing diabetes subsequent to depression [24,25]).

To better understand the relationship between type 1 diabetes and psychiatric disorders, there is a need for controlled studies using cohorts of patients who have had a recent onset of diabetes. No study following such a design, including the reports of psychiatric diagnoses, has been performed so far. Therefore, the aim of our study was to determine if newly diagnosed adults with type 1 diabetes have an elevated rate of psychiatric disorders in the beginning of their physical illness.

Research design and methods

Study design

We compared 313 adult inpatients at the time of their type 1 diabetes diagnosis to a national representative sample ($N = 2046$). Patients were consecutively recruited from January 1996 to May 1999. In Germany, at that time, the usual treatment for a new-onset type 1 diabetes case was inpatient treatment. Therefore, we included only inpatients in order to get a representative sample. To avoid institutional selection bias, we conducted the study in different types of clinics and included 12 hospitals distributed all over Germany. The following criteria were applied for inclusion: recent type 1 diabetes diagnosis that was mostly diagnosed by general practitioners (maximum 12 weeks beforehand) and confirmed in hospital, the ability to understand German sufficiently, and an age between 17 and 40 years. We chose the lower age limit because we wanted to investigate only adults. The upper age limit was chosen to avoid the unintentional recruitment of type 2 diabetes patients who had been misdiagnosed as type 1.

The eligible sample consisted of 347 adult patients who were treated on average for 1 week in the cooperating hospitals during the recruitment period. Thirty-four patients declined to participate (9.8%). Informed, written consent was obtained from the 313 patients (90.2%) who were willing to participate in the study. Most patients were recruited in general hospitals (80.8%), followed by those in rehabilitation clinics (11.8%); a minority was treated in university clinics (7.4%). There was a small, unexplained overrepresentation of males in the sample (62.3%). As there were no significant gender differences in the group of refusals compared to the enrolled subjects, we could exclude a bias caused by a higher proportion of female refusals.

To test the hypothesis of an increased prevalence of psychiatric disorders in patients with diabetes, the prevalence of 6 main disorders including 19 subgroups were compared to those of the reference group. We chose a sample as a reference group from a large, representative survey that was conducted in 1998 as a nationwide, epidemiological study of mental health in Germany [26]. To be included in the present reference group, subjects had to fulfil two criteria: they were not allowed to have type 1 or type 2 diabetes, and they had to be between 17 and 40 years of age. This sample was especially suitable for testing our hypotheses, as the two studies were conducted at nearly the same time and the 1998 sample was large enough to select a subgroup of subjects who were within the same age range as the diabetes group. Another strength of the 1998 study was the inclusion of a medical examination of the subjects by physicians; these examinations allowed us to exclude diabetic patients from the reference group. A two-stage assessment was used for the recruitment of the reference group. In the first stage, 6159 subjects (18–65 years of age) of a representative population sample were screened for psychiatric disorders by a self-report questionnaire after completing the biomedical health status examination. The second stage involved separate administration of a structured interview to all those who screened positive ($n = 3474$) and to a random sample of almost 50% of the participants who screened negative ($n = 1301$). A total of 4181 respondents completed this second stage (response rate 87.6%). Data were weighted to the screen-positive/screen-negative sampling scheme, age, sex, and geographic location to match the distribution of the sampling frame (for more details, see [27]). This procedure yielded a representative German population segment of 2046 persons. A description of both samples is given in Table 1.

Assessment of psychiatric disorders

The one-month prevalence of psychiatric disorders was measured in both samples using interviews designed to provide diagnoses according to DSM-IV [28]. The Diagnostic Interview for Mental Disorders (DIMD-short version), a structured interview, was used by trained psychologists to assess the psychiatric disorders of the

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Table 1. Characteristics of adults with type 1 diabetes compared to a general population reference group

	Type 1 diabetes	Reference group[a]	$p \leq$
Characteristics	($N = 313$)	($N = 2046$)	
Age (years, means/SD)	28.2/6.3	30.2/6.4	0.001[c]
Body mass index (kg/m^2; means/SD)	22.9/3.3	25.0/4.1	0.001[c]
Sex (%/*N*)			0.001[d]
Male	62.3/195	50.8/1039	
Female	37.7/118	49.2/1007	
Marital status (%/*N*)			0.001[d]
Unmarried	64.9/203	44.6/893	
Married	30.4/95	48.4/969	
Divorced/separated/widowed	4.8/15	7.1/142	
Years of formal education (%/*N*)			n.s.[d,e]
<10	24.9/76	27.8/542	
<14	64.9/198	60.0/1172	
≥14	10.2/31	12.2/238	
Occupation (%/*N*)			0.001[d]
Unemployed	7.1/22	5.4/105	
Blue-collar worker	21.3/66	26.5/514	
White-collar worker/civil servant	42.9/133	39.0/756	
Self-employed	4.5/14	6.7/129	
Pupil/student/trainee	15.5/48	11.7/226	
Others	6.8/21	7.4/144	
Insulin treatment regimen (%/*N*)			
Conventional insulin therapy	3.8/12	n.a.[b]	
Intensified insulin therapy	96.2/301	n.a.[b]	
Weeks since diabetes diagnosis (median/interquartile range)	4.4 (2.4–4.4)	n.a.[b]	

Differences in the indicated *N* result from missing data; SD, standard deviation.
[a]Weighted percentages.
[b]n.a. denotes not applicable calculations.
[c]Students *t*-test.
[d]Chi^2-test.
[e]Not significant.

diabetic patients during their inpatient treatment [29]. It is a short form of the well-evaluated Diagnostic Interview for Mental Disorders (DIMD) [30–32], a German adaptation of the American Anxiety Disorders Interview Schedule-Revised (ADIS-R) [33]. The DIMD-short version has a high sensitivity, which means that in the case of diagnostic errors there is a higher probability for false-positive results than for false-negative ones [29]. It has proved to have an excellent inter-rater reliability ranging from 0.84 to 1.0 in terms of Cohen's Kappa and from 0.89 to 1.0 in terms of Yule's Y-coefficients for the major groups of disorders. For individual disorders, the inter-rater reliability was also very good (Kappa values between 0.84 and 1.0, Yule's Y from 0.75 to 1.0) [31]. The DIMD-short version allows for the diagnosis of anxiety disorders, affective disorders, substance-related disorders, somatoform disorders and eating disorders, and a screening of psychotic disorders [29].

By contrast, the diagnoses in the reference group were performed with the Composite International Diagnostic Interview (CIDI) version 1.2 [34], a widely used and well-evaluated instrument, too. In the above-described two-stage assessment, the Munich Composite International Diagnostic-Screener (CID-S) [35] was used as a self-report questionnaire. The second stage was accomplished by using the Munich Composite International Diagnostic Interview (M-CIDI) [36], a standardized, modified version of the CIDI, supplemented by questions to cover DSM-IV criteria. A more detailed description of the sample recruitment and diagnostic procedure has been described in a previous report [27].

Statistical analysis

The prevalence of psychiatric disorders was calculated using frequency procedures without a statistical test of hypotheses. The data in the general population group were weighted to give a representative German population estimate [27]. In view of the consecutive recruitment of the sample of diabetic patients, weighting was regarded as inappropriate in this sample and was not performed. Bivariate comparisons were performed by chi^2 tests. Adjusted odds ratios (ORs) and 99% confidence intervals (CIs) were obtained from logistic regression analyses. Controlled confounders in all models were gender, age, body mass index, marital status, years of formal education (recoded in three groups, <10, <14, ≥14). According to current recommendations about the number of explanatory variables in logistic regressions [37], no corrections for confounders were computed when the prevalence in either group was lower or equal to $N = 30$. Owing to the sample size, the alpha level was

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set to $P < 0.01$ in all tests, which were two-tailed. The statistics were performed using SPSS V 8.0 [38].

Results

The prevalence of the psychiatric disorders in both groups, together with statistical tests and odds ratios, are presented in Table 2. For the mood disorders in general, which include major depressive and manic episodes as well as dysthymic disorders, no significant differences between both samples were found. Regarding the diagnostic subgroups, however, the diabetes group had a prevalence rate of 5.8% for major depressive episodes, which is roughly twice that of the reference group with only 2.7% and is significant at the 1% level. The estimated odds ratio was 2.5, with a 99% CI between 1.1 and 5.0.

For the anxiety disorders, as well as all other diagnostic subgroups, no significant differences could be found between the two samples. The most common disorders in both groups were the simple phobias.

Regarding somatoform disorders, the results indicate a significantly lower prevalence rate for the diabetes group than for the reference group. For the eating disorders, the prevalence rates are very low in both groups. Regarding anorexia nervosa and bulimia nervosa, no significant differences could be observed. As for the substance-related disorders (including disorders caused by alcohol, illegal drugs, and medication abuse or dependency), the diabetic patients showed significantly lower rates than the reference group. For psychotic disorders, we performed only the screenings, which are designed to be sensitive but not very specific. The diabetes group manifested none of these psychiatric disorders, whereas 1.5% of the reference group had them. These differences were not significant.

The point prevalence of any of the above-mentioned psychiatric disorders is 12.5% in the diabetes group compared to 18.4% in the reference group. After the adjustment for confounders, the difference was found to be slightly above the probability level of $P < 0.01$, indicating that patients with type 1 diabetes and the references did not differ significantly.

In conclusion, we found significant differences in the prevalence rates between the diabetes sample and the reference group with respect to the three disorders. As it is well known that almost all mental disorders are more prevalent in women than in men [39,40], we undertook subsequent explorative comparisons of the diabetic patients with the general population group separately for women and men. Owing to the small subsample sizes, we used chi^2 tests without additional logistic regression analyses.

Table 2. Point prevalence of psychiatric disorders in adults with type 1 diabetes compared to a general population reference group

Psychiatric disorders (DSM-IV, axis I)	Type 1 diabetes (%/N)	Reference group (%/N)	chi^{2a}	P^b	$P_{ADJ}{}^c$	Adjusted odds ratio (99% CI)^d
Anxiety disorders	7.7/24	9.5/194	1.07	0.302	0.513	0.8 (0.5–1.7)
Agoraphobia with/without panic	1.9/6	1.6/32	0.21	0.644	0.253	1.7 (0.5–5.0)
Panic with/without agoraphobia	1.0/3	1.1/23	0.07	0.794	n.a^e	n.e.^{f}
Social phobia	2.2/7	1.3/26	1.84	0.176	n.a	n.e.
Simple phobia	2.9/9	5.3/109	3.44	0.064	0.119	0.6 (0.2–1.4)
Generalized anxiety disorder	1.0/3	0.7/14	0.28	0.594	n.a	n.e.
Obsessive-compulsive disorder	0.3/1	0.4/8	0.04	0.848	n.a	n.e.
Mood disorders	6.1/19	5.0/103	0.59	0.441	0.380	1.3 (0.6–2.5)
Major depressive episode	5.8/18	2.7/55	8.49	0.004	0.003	2.5 (1.1–5.0)
Manic episode	1.0/3	0.4/9	1.44	0.230	n.a	n.e.
Dysthymic disorder	1.0/3	2.3/48	2.45	0.117	0.153	0.4 (0.1–2.0)
Somatoform disorders	1.9/6	5.9/120	8.37	0.004	0.008	0.3 (0.1–1.0)
Somatization disorder	0.6/2	0.2/4	2.10	0.147	n.a	n.e.
Hypochondriasis	0.6/2	0.0/1	n.a	0.048	n.a	n.e.
Pain disorder	1.0/3	4.3/87	8.03	0.005	0.011	0.2 (0.0–1.0)
Eating disorders	1.0/3	0.3/7	2.44	0.118	n.a	n.e.
Anorexia nervosa	0.0/0	0.0/1	0.15	0.696	n.a	n.e.
Bulimia nervosa	1.0/3	0.0/1	n.a	0.008	n.a	n.e.
Substance abuse/dependence	1.0/3	4.1/84	7.57	0.006	0.007	0.2 (0.0–0.9)
Alcohol abuse/dependence	1.0/3	3.4/69	5.35	0.021	0.025	0.3 (0.1–1.3)
Illicit substance abuse/dependence	0.0/0	0.8/16	2.46	0.116	n.a	n.e.
Medication abuse/dependence^g	0.0/0	0.0/1	n.a	1.00	n.a	n.e.
Possible psychotic disorder	0.0/0	1.5/30	4.65	0.031	n.a	n.e.
All psychiatric disorders	12.5/39	18.4/377	6.65	0.010	0.011	0.6 (0.4–1.0)

[a]chi^2 denotes the chi-square test. All degrees of freedom in the chi-square test = 1.
[b]P values were calculated by the chi-square test.
[c]$P_{ADJ} = P$ adjusted for potential confounders (gender, age, body-mass-index, marital status, years of formal education) in logistic regression analysis.
[d]odds ratios were adjusted for potential confounders (gender, age, body-mass-index, marital status, years of formal education).
[e]n.a. denotes not-applicable calculations.
[f]n.e. = not estimated owing to observed number of subjects with positive diagnosis $\leq$30.
[g]This group included sedative-, hypnotic-, or anxiolytic-related disorders according to DSM-IV.

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The only psychiatric disorder that showed increased rates in the diabetes group was the major depressive episode. This result was significant only for women (9.3% diabetes group vs 3.2% reference group, chi^2: 10.85, $p = 0.003$) but not for men (3.6% diabetes group vs 2.2% reference group, not significant). In addition, there were two disorders with lower prevalence rates in the diabetes sample: substance abuse/dependency was significantly less common among men of the diabetes group compared to men of the reference group (1.5% diabetes group vs 6.3% reference group, $chi^2 : 7.0, p = 0.006$; women 0% diabetes group vs 1.8% reference group, not significant). On the other hand, somatoform disorders were significantly lower only for women of the diabetes group (1.7% diabetes group vs 8.4% reference group, chi^2: 6.74, $p = 0.006$; for men, 2.1% diabetes group vs 3.3% reference group, not significant).

Conclusion

This is the first study to examine a large, new onset cohort of adult type 1 diabetes patients. A main finding of our study is that type 1 diabetes patients have an odds ratio of major depressive episodes that is already double that of the general population at the time of diagnosis of diabetes. A recent meta-analysis [1], which includes patients with type 1 diabetes as well as patients with type 2 diabetes, found, as the 'principal conclusion', a similar odds ratio of 2.0 for depression in comparison to control groups. There appears to be a discrepancy between the 9.0% prevalence rates for major depression in this meta-analysis of controlled studies using diagnostic interviews compared to our results of a rate of 5.8%. These differences may be due to variations in moderators such as disease duration, age, sex, study design, and type of diabetes. In this case, it seems more appropriate to refer to the odds ratios that were computed for each study separately. In conclusion, a consideration of the present findings in light of those of the meta-analysis suggests that the increased rate of depression has already reached its expected maximum at the beginning of the diabetes.

Our finding that there are significant gender differences in the prevalence rates, especially for major depressive episodes, is a result of subsequent analyses. This finding requires replication in an independent sample before it can be generalized. However, a first hypothesis could be that women are more likely than men to react with depression when confronted with the beginning of a lifelong chronic disease such as type 1 diabetes.

The hypotheses about the association between depression and type 1 diabetes could be grouped into three categories. First, depression precedes diabetes, a possibility that we cannot rule out because we had assessed point-prevalence rates and had no information about the lifetime diagnoses of the patients. This hypothesis can be extended to the question of whether depression can contribute to the onset of diabetes. The existence of a cause and effect relationship seems to be the case for type 2 diabetes; however, to date there is no available evidence for such causality in type 1 diabetes (for a comprehensive review, see [9]).

Second, as a new hypothesis, the higher rates of depressive episodes could be regarded as an immediate reaction to the impairment due to the symptoms of untreated diabetes or as endocrinologically mediated complications of the diabetes. This would mean that the depressive reaction is unrelated to the long-term burden of diabetes. A third possible explanation is to regard the subsequent diagnosis of the diabetes, as well as the inpatient treatment, as a psychological stress factor that has to be coped with. Initial adjustment problems could also promote a depressive reaction.

For all other psychiatric disorders, the results of this study lead to the rejection of the hypothesis that type 1 diabetes patients have more psychiatric disorders than the general population. This is true at least at the time of the diagnosis of diabetes. An interpretation of these findings could be that (with the exception of depression) the elevated rate of psychiatric disorders found in previous cross-sectional studies [3,41] is due to accumulated illness burdens in the course of the physical disease. However, substantiating this hypothesis is only possible if an increase in psychiatric disorders could be observed during the course of the diabetes in studies with longitudinal research designs.

There are some limitations to our study. The most obvious one is the use of different interview techniques in the groups compared. For the diabetes sample, we decided to use the DIMD-short version, a highly sensitive, structured interview that was applied by trained psychologists in the different clinics. For the reference group, the data collection was performed by one of the usual instruments for epidemiological studies, in our case the M-CIDI. Theoretically, this disparity in interview methods may lead to artificial differences in the obtained prevalence rates; however, both instruments are based upon the DSM-IV criteria and consequently assess the same symptomatology. As the use of different diagnostic interviews for the same diagnostic criteria has been proven to be valid in general [42–44], there is no reason to assume relevant discrepancies in the prevalence here. Nevertheless, we hypothesized that the diabetes group would have higher prevalence rates of various psychiatric disorders than the reference group. However, we found either no significant differences (with a trend towards lower prevalence rates in the diabetes group for all psychiatric disorders) or even a significantly lower prevalence (for somatoform disorders). If there were a measurement error, it would be more likely to go in the direction of overestimating the prevalence rates in diabetic patients, as the DIMD-short version is conceptualized as a highly sensitive instrument. Against this background, the rejection of the general hypothesis of increased rates of psychiatric disorders can be regarded as sound. Another criticism could address the finding of the increased rates for depressive episodes. For two

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reasons, however, we think that this result is not biased, either. First, the results are plausible and in tune with the current scientific literature. Second, there is no reason for an overestimation of psychiatric disorders to have occurred specifically for depressive episodes and not for the other disorders.

A further limitation is that the DIMD did not measure adjustment disorders DSM-IV 309.0 to 309.9, with or without depressed mood or anxiety. On the other hand, according to DSM-IV, severe depression or anxiety symptoms would have led to the diagnoses of mood or anxiety disorders. Hence, it is possible that we have overlooked minor symptoms, but we are certain that we have not overlooked important psychopathology. Finally, it is important to mention that our results are representative of only adult type 1 diabetes patients between 17 and 40 years of age.

Apart from these limitations, our study has some specific advantages over previous ones. In the field of psychosocial diabetes research, most studies were conducted in specialized institutions and in one or two hospitals. It is almost inevitable that this type of sample recruitment leads to selection bias. To avoid such bias, we used a consecutive recruitment of patients and carried out a large multicenter study with different institutions distributed all over Germany, ranging from general hospitals to university clinics. In our study, the rates of refusal were low (9.8%), and the total sample seems to represent adequately the situation of newly diagnosed type 1 diabetes patients. Other strengths of our study design lie in the sample size, the homogeneity of our type 1 diabetes group in terms of disease duration, and the use of a general population group as the reference group. Actually, the other new onset cohort studies had been conducted with children and adolescents; the samples sizes varied between 60 to 100 subjects with control groups of almost the same size [45–47]. Irrespective of the differences in sample size, it is obvious that the psychological characteristics of adults differ from those of children.

In view of the poor knowledge about the association of psychiatric disorders with diabetes, there is a strong need for prospective longitudinal research in order to analyse the pathways and the time of onset of psychiatric disorders in the course of the somatic illness as well as the possible differences in the recurrence of psychological disorders in the diabetes group compared to control or reference groups.

With regard to clinical practice, the following conclusions can be drawn: clinicians who treat adult patients with newly diagnosed type 1 diabetes do not have to expect an increased occurrence of psychiatric disorders in general. However, they may want to pay more attention to the possible depressive reactions of their patients. It is known that there are low detection rates for depression [48], suggesting underdiagnoses and subsequent undertreatment of mood disorders in diabetic patients. Depression may serve as a marker of vulnerability and help identify a subgroup of patients at risk for complications.

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