

Psychotic experiences in the general population: A twenty-year prospective community study

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Abstract

Purpose: Recent work suggested that psychosis might be expressed at subclinical levels. However, the determinants of subclinical psychotic symptoms, the degree of continuity over the life span, and the impact on functioning remain unclear. Thus we analyzed the prevalence, determinants, patterns and impact of subclinical psychotic symptoms in a community cohort over a 20-year period.

Methods: The Zurich Study – a longitudinal community study – started in 1979 with a sample of 591 participants aged 20/21 years. Follow-up interviews were conducted at age 23, 28, 30, 35 and 41. Symptoms were assessed with a semi-structured interview and the SCL90-R. In this analysis, items of the SCL90-R symptom dimensions “paranoid ideation” and “psychoticism” were examined.

Results: Two distinct symptom dimensions of subclinical psychosis became evident, one representing schizophrenia nuclear symptoms, the other representing schizotypal signs. Cannabis use in adolescence was associated specifically with schizophrenia nuclear symptoms, whereas childhood adversity as well as chronic physical or mental disorders in parents contributed to schizotypal signs. Individuals with a persistently high level of either of the two identified symptom dimensions over 20 years experienced significant deficiencies in social achievement and functioning.

Conclusions: Expression of psychotic symptoms in populations is continuous and characterized by differing levels of severity and persistence. A small group of individuals displays persistence of subclinical psychotic symptoms over a period of 20 years. The causes of and pathways to clinical psychotic disorder can be studied long before the disorder becomes clinically relevant.

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1. Introduction

In clinical practice, mental health professionals identify individuals with psychosis by the presence of characteristic criteria, which are assumed to represent the core features of the disorder. However, the clinical

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procedure does not identify a valid categorical phenotype. For example, in the National Comorbidity Survey, Kendler and colleagues reported a general population rate of broadly defined, clinician-assessed psychotic disorder of 0.7%, but 28% of the population had been screened positive for psychosis (Kendler et al., 1996). In the Dutch NEMESIS study, a general population sample, 17.5% endorsed at least one psychosis item, but only 2.1% received a DSM-III-R diagnosis of non-affective psychotic disorder (van Os et al., 2000). A rate of 17.5% for psychotic symptoms was also reported in a general population sample of adolescents and young adults in Germany (Spauwen et al., 2003). A lower proportion, some 5.5%, positively endorsed the items of the Psychotic Screening Questionnaire in the 2000 British National Survey of Psychiatric Morbidity (Johns et al., 2004). It is likely that the variation of prevalence rates is at least in part a consequence of the different instruments used.

Questionnaire items such as “others are to blame for your troubles and cannot be trusted” or “having ideas that others do not share” are commonly endorsed. At a cultural level, a certain fear or mistrust of others is incorporated in social life. In general, such beliefs and attitudes are not clinically relevant as long as they are not excessive, grossly exaggerated or become associated with significant distress. Even hallucinations can occur in “normal” individuals (Eaton et al., 1991; Johns et al., 2002; Tien, 1991).

Unlike depression (Harrington et al., 1990) there is little information on the continuity of psychotic symptoms over the life span. Chapman and colleagues found several items relating to psychosis proneness, in particular scoring high on the Perceptual Aberration Scale or the Magical Ideation Scale, predicted psychotic disorder 10 years later (Chapman et al., 1994). Poulton and colleagues provided the first evidence for continuity of prevalent psychotic symptoms in childhood to psychotic disorder in adulthood, albeit in a minority of 25% of individuals (Poulton et al., 2000). The NEMESIS Study was the only to examine the rate of persistence of incident psychotic experiences. In this study, the rate of persistence was 16% over 2 years, half of which was clinically significant (Hanssen et al., 2005). In a 3-year follow-up of a cohort of children with prevalent auditory hallucinations, the rate of persistence was higher at 40% (Escher et al., 2002).

All the above studies were limited in that the outcome was studied over variable time intervals without the possibility for examining the dynamics of the longitudinal course. In addition, while subclinical psychosis is associated with deficiencies in social

achievement and functioning (Johns et al., 2004; van Os et al., 2000), there is no information on how subclinical psychosis becomes associated with such deficiencies over time. This issue is the key to understanding the link between phenotypic expression and clinical relevance. However, there has been little work examining dimensional and categorical aspects of subclinical psychosis.

In the current study, therefore, the aims were: i) to determine the prevalence of subclinical psychotic symptoms in the Zurich cohort — a 20-year prospective community sample, ii) to apply multivariate techniques to further delineate symptoms dimensionally and categorically, iii) to identify the 20-year course of those symptoms, iv) to identify predictors and v) to investigate if and how these symptoms become associated with deficiencies in social achievement and functioning over time. We hypothesized that a significant proportion of the population would display subclinical psychotic symptoms over the life span, that at least one symptom dimension would consist of recognizable “schizophrenic” core symptoms (Verdoux et al., 1998a), and that expression of psychotic symptoms would be associated with previously reported risk factors such as younger age (Verdoux et al., 1998b) and cannabis use (Henquet et al., 2005a). It was further hypothesized that a minority of individuals would have persistent expression of psychosis, and that in particular in these associations with deficiencies in social functioning would be apparent.

2. Methods

2.1. Sample

The Zurich Study sample was selected on the basis of a two-phase procedure as described by Dunn et al. (1999), which is fairly common in epidemiological research. It is characterized by a screening part and an interview part, whereby the latter is carried out with a subsample of the initially screened subjects, typically stratified along selected criteria and cut-offs. In statistical analysis, the stratified data need to be weighted for receiving correct point estimates such as prevalence rates.

The screening procedure in the Zurich Study took place in 1978 with a sample of 4547 subjects (2201 males; 2346 females) born in 1958 and 1959 representative of the canton of Zurich in Switzerland. At that time, the male participants were 19 years old (at mandatory conscription) and the females 20 years old (complete electoral register). In Switzerland each male

citizen has to present himself for military conscription. With permission from the authorities and independently of the military procedure, we could screen randomly half of the conscripts. The refusal rate was 0.3%. The females were identified at the age of 20 by the complete electoral register; half of the women chosen randomly received mailed questionnaires and 75% of them responded. A lower educational level was over-represented among non-responding women; in order to correct for that the female interview sample was matched by educational level to the male sample. All subjects received the Symptom Checklist 90-R (SCL90-R) (Derogatis, 1977), a comprehensive self-report questionnaire of 90 questions, which covers a broad range of psychiatric symptoms, and a demographic questionnaire.

With regard to the second phase, a stratification procedure was applied in order to enrich the interview sample with cases at risk for the development of psychiatric syndromes. Stratification was based on a cut-off value of the SCL90-R global severity index (GSI) score. Two-thirds of the interview sample comprised high scorers (defined by the 85th percentile or above on the SCL90-R GSI scores) and one-third of the interview sample were randomly selected from the rest of the initial sample (GSI scores below the 85th percentile). 591 subjects (292 males, 299 females) were selected for interview.

Face-to-face interviews were conducted with the interview sample at ages 21, 23, 28, 30, 35 and 41 years. Over 20 years, 62% of the original sample continued to participate in the study and the following proportions participated in specific numbers of interviews: 47% in all six interviews; 63% in five interviews; 74% in four interviews; 82% in three interviews; and 91% in at least two interviews. Those who dropped out did not differ significantly from those who stayed in follow-up interviews regarding psychiatrically relevant demographic characteristics (Eich et al., 2003). The analyses reported below are based on 372 “stayers” — participants who completed five or all six interviews.

2.2. Study instruments

The detailed interviews in the Zurich Study were conducted with the SPIKE (Structured Psychopathological Interview and Rating of the Social Consequences of Psychological Disturbances for Epidemiology) — a semi-structured psychopathological interview developed for epidemiological studies which has been used in all waves since 1979 (Angst et al., 1984). The successive SPIKE versions have allowed us to make

diagnoses according to DSM III, III-R and IV with the exception that diagnoses of psychotic disorders could not be confirmed as the necessary criteria were not included. SPIKE also recorded data concerning treatment, medication, service use, and impairment in work, social, and leisure activities. Data on the reliability and validity of this instrument have been reported elsewhere (Merikangas et al., 2003). Other instruments used in all interview waves were a life events list according to the scales of Holmes/Rahe (Holmes and Rahe, 1967) and Tennant/Andrews (Tennant and Andrews, 1976) and the SCL90-R (Derogatis, 1977).

In the SCL90-R, subjects respond on a five point Likert scale of distress ranging from “not at all” (0) at one pole to “a little bit” (1), “moderately” (2), “quite a bit” (3) and “extremely” (4) at the other. The time period covered by the SCL90-R in the Zurich Study was 4 weeks. The 90 items of the SCL90-R are grouped along nine symptom dimensions reflecting broad psychological symptom status in a spectrum of individuals ranging from well controls to somatic and psychiatric patients. The two symptom dimensions relevant for psychosis (“paranoid ideation” and “psychoticism”) were used for analysis. According to the SCL90-R manual, the six-item dimension “paranoid ideation” is characterized by projective thoughts, hostility, suspiciousness, grandiosity, centrality, fear of loss of autonomy and delusions. The dimension “psychoticism” (10 items) includes items indicative of a withdrawn, isolated, schizoid life style as well as items representing symptoms of psychosis and schizophrenia such as hallucinations and thought broadcasting. The SCL90-R has shown good internal consistency and test–retest reliability (Derogatis and Cleary, 1977; Derogatis and Melisaratos, 1983; Hafkenscheid, 1993; Schmitz et al., 2000). However, the factor structure of the instrument has shown inconsistent results. Commonly, less than nine factors are identified (Schmitz et al., 2000), and the psychoticism dimension has been shown to yield the least consistent results (Olsen et al., 2004). Such inconsistencies have been reported since the very first stages of development of SCL90-R (Derogatis and Cleary, 1977).

2.3. Analysis steps and statistical models

The analyses were conducted in several steps as shown in Fig. 1. The first two steps — missing value analysis and factor analysis — served in the first place to prepare for the subsequent analyses by improving the data base and rebuilding the psychotic experiences subscales.

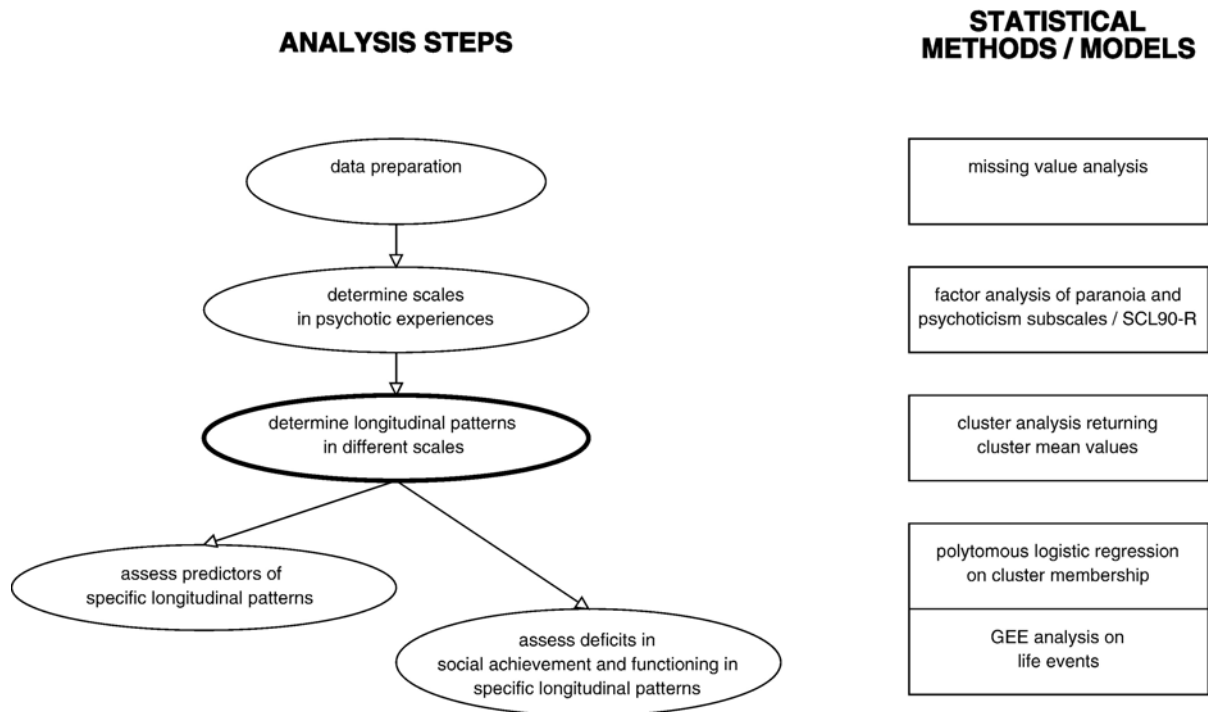


Fig. 1. Analysis design showing the analysis steps and the corresponding statistical methods and models.

The central idea behind our consecutive analyses was that subclinical psychotic experiences can be displayed along typical age-related longitudinal patterns and that such patterns allow us to classify subgroups of subjects more precisely than could be done in cross-sectional analyses. Moreover, in case there are distinct syndromes representing psychotic experiences, their longitudinal patterns need to be analyzed separately. Cluster analyses were conducted to determine these longitudinal patterns. As a consequence each participant was classified according to the respective longitudinal pattern. This classification was used for the two following analyses. On the one hand we examined putative predictors of the subgroup membership (i.e. the respective longitudinal pattern). In (polytomous) logistic regression various childhood, youth and other variables were regressed on the subgroup membership. On the other hand we examined the consequences of subgroup membership on a series of outcome variables representing social achievement and functioning between 1979 und 1999. This step was conducted by means of a generalized estimating equations (GEE) analysis.

2.3.1. Improving the data base by missing value analysis

Multiple steps analyses benefit from optimal prerequisites like complete and consistent data. Missing

value analysis (MVA) was used to replace missing values in the SCL items, thus allowing inclusion of all 372 “stayers” who participated five or six times. Otherwise, the analyses would have been restricted to 278 subjects participating in all 6 interviews. MVA was carried out using the expectation maximization (EM) algorithm in the SPSS MVA procedure, which relies on iterative use of regression models (SPSS V11.0.4/ Macintosh).

2.3.2. Determining new symptom dimensions for psychotic experiences

Given the uncertain validity of the SCL90-R psychosis symptom dimensions, and the perceived need for reanalysis as reported in other studies (Fergusson et al., 2003), factor analysis with promax rotation (Lewis-Beck, 1994) was used to determine classes of psychotic experiences in the paranoid ideation and psychoticism dimensions of the SCL90-R. Factor analysis was carried out with the PROC FACTOR procedure of SAS (V8.2/Windows). The longitudinal data in the Zurich Study allowed replicating and thus validating the factor structure. All analyses were constrained to two factors. The items consistently loading jointly on the same factor were selected to determine different symptom dimensions of psychotic experiences and to build two new symptom dimensions.

As a consequence, several items of the psychoticism dimension were excluded from further analysis. The new symptom dimensions were transformed into sum scores.

2.3.3. Defining longitudinal patterns for each new symptom dimension

Cluster analysis (Everitt, 1993) served to characterize different groups of respondents along their scores of the newly built symptom dimensions. *K*-Means cluster analysis was carried out with the Quick Cluster procedure of SPSS (SPSS V11.0.4/Macintosh) and was conducted for each new dimension separately. Thus, each person was assigned to a cluster separately for each of the two scales. Given that the analysis was based on a person-level data set (the scores in each interview were represented by single variables) the cluster centers can be read as cluster specific values for each interview. Depicted on a time axis they result in characteristic longitudinal patterns.

2.3.4. Analysis of predictors

In order to identify specific predictors for the longitudinal patterns of each new symptom dimension, we conducted a series of polytomous logistic regression analyses each including a predictor, sex and 1978 baseline high vs. low scorer status in SCL90-R. These analyses were again based on the person-level data set. The information regarding predictors was derived from the 1979 interview, the screening interview in 1978 or retrospective questions about childhood and youth asked in the 1986 and 1988 interviews. Thus, it covers circumstances and events, which preceded the interviews in 1979. The tested predictors included demographic and socioeconomic characteristics (education, place of living, religious affiliation, marital status of parents, living with parents), chronic illness of parents (mother/father, mental and/or physical), problems and conflicts with parents (frequency of contacts, conflicts, dominance patterns, emotional burden, quarrels between parents, neglect, punishment, running away from home), problems and conflicts in the school (violence, being an unpopular mate, fear of school teacher, frequent truancy), drug use in 1979 (opioids, alcohol, cannabis, smoking, hallucinogens).

2.3.5. Analysis of social outcomes

Deficiencies in social achievement and functioning were assessed utilizing the life event items. These items referred to events in working life (conflicts at the place of work, job degradation and job promotion, dismissal from work, unemployment), change of the place of

living, legal problems (problems with the police, imprisonment), in partnership (engagement, marriage, problems, separation, being left by partner, divorce) and in family (death of partner or parent, illness). To compare these outcomes with regard to the characteristic longitudinal patterns within each of the new symptom dimensions, generalized estimating equations (GEE) analyses were carried out. The data set was analyzed in a long data format, i.e., as a person-period data set. In these analyses one person contributed multiple observations (one for each follow-up). The GEE models (Twisk, 2003) assessed simultaneously the data from all interviews. They account for the serial dependence of observations by directly introducing the within-subject correlation structure of the data. We used an exchangeable correlation structure. This analysis was done with the PROC GENMOD procedure of SAS (V8/Windows). As in the polytomous logistic regression analyses reported above, no adjustment was introduced for multiple testing.

3. Results

3.1. Endorsement rate at different ages

The proportion of the population endorsing one or more of the 16 self-reported symptoms from the symptom dimensions “psychoticism” and “paranoid ideation” of the SCL90-R at each interview is listed in Table 1. A considerable proportion of the sample displayed psychotic experiences within a four-week period at any interview. Most symptoms showed a decline over 20 years. For example, in the original psychoticism dimension, the highest four-week prevalence rate at age 20/21 was reported for the variable “someone else can control your thoughts” (38.3% — value represents population values after offsetting the sample stratification). This proportion had more than halved at age 40/41 (15.2%). About one fifth of the population endorsed at age 20/21 the item “others being aware of your thoughts” (18.5%) and “having thoughts that are not your own” (22.6%); by age 40/41 only 4.7% and 7%, respectively, reported those ideas. The proportion of persons who reported auditory hallucinations decreased from 3.2% at age 20/21 to 1% at age 35/36 and 0.1% at age 40/41.

A few symptoms did not follow this pattern of decline. For example, a consistently high proportion reported feelings of alienation: “feeling lonely even when with people” (33.8% at age 20/21 and 29.4% at age 40/41) and “not feeling close to another person” (21.5% at age 20/21 and 22.9% at age 40/41). A

Table 1

Proportion of affirmative answers for the symptom dimensions “psychoticism” and “paranoid ideation” of the SCL90-R over 20 years and six interview waves (reweighted to offset the sample stratification); values displayed for different cut-offs

Subscale/items	Cut-off: a little bit						Cut-off: moderately						
	Interview/ age	20/21	22/23	28/30	30/31	35/36	40/41	20/21	22/23	28/30	30/31	35/36	40/41
<i>Psychoticism</i>													
Someone else can control your thoughts		38.3	25.1	16.9	19.5	13.6	15.2	13.1	7.5	4.2	3.0	4.5	4.2
Hearing voices other people don't hear		3.2	2.2	1.0	1.1	1.0	0.1	0.4	0.3	0.7	0.1	0.2	0.0
Other people being aware of your private thoughts		18.5	14.2	10.0	11.6	8.7	4.7	6.3	5.1	2.7	2.0	2.0	1.0
Having thoughts that are not your own		22.6	17.7	9.0	8.0	9.1	7.0	6.1	2.2	2.6	1.5	1.1	0.5
Feeling lonely even when with people		33.8	26.5	27.4	29.9	23.3	29.4	12.8	7.7	6.4	4.9	6.2	7.7
Thoughts about sex that bother you		30.8	19.9	20.2	21.2	22.3	22.3	11.1	7.7	6.1	5.5	7.5	8.3
The idea that you should be punished for sins		14.2	8.8	9.7	8.3	6.7	9.9	2.9	1.9	1.6	2.6	0.7	2.8
The idea that something is wrong with your body		29.2	23.7	24.2	28.0	29.3	29.7	9.8	4.3	8.8	7.9	5.2	7.6
Never feeling close to another person		21.5	17.5	24.4	25.4	20.4	22.9	10.3	6.6	5.0	6.7	4.8	6.9
The idea that something is wrong with your mind		7.5	6.4	6.5	4.3	8.2	7.3	2.8	3.1	2.2	1.4	0.9	2.3
<i>Paranoid ideation</i>													
Feeling others are to blame for your troubles		27.0	21.9	18.1	24.0	23.1	20.6	6.7	3.5	4.6	5.2	6.8	5.3
Feeling that most people cannot be trusted		37.1	31.6	30.2	23.3	24.8	29.2	12.7	8.4	5.2	5.3	4.5	8.3
Feeling that you are watched by others		42.8	33.1	23.4	31.5	29.5	33.3	9.5	4.8	4.5	7.8	6.4	6.4
Having ideas that other do not share		58.0	50.1	39.4	40.0	36.1	32.0	22.4	20.9	13.4	13.8	11.2	9.3
Others not giving you proper credit		42.4	30.2	32.6	43.3	50.6	42.3	10.0	8.9	8.5	13.1	13.5	12.5
Feeling that people take advantage of you		32.0	36.4	30.4	33.4	33.9	36.5	10.6	8.9	7.8	6.1	7.5	10.6

higher proportion of symptomatic items endorsed were on the symptom dimension “paranoid ideation”, compared to the symptom dimension “psychoticism”. The item with the highest rate of endorsement was “having ideas that others do not share” (58.0%) at age 20/21 in 1979.

3.2. Factor analysis identifying SCL90-R symptom dimensions

The factor analyses revealed fairly consistent patterns for each interview (Table 2). The first factor regularly included paranoid ideation items as well as the items “feeling lonely even when with people” and “never feeling close to another person” from the original psychoticism dimension. This factor addresses social and interpersonal deficiencies with reduced capacity for close relationships as well as ideas of reference, odd beliefs and suspiciousness or paranoid ideation. As such this factor is reminiscent of criteria required for a diagnosis of a “schizotypal personality disorder”. It will be referred to hereafter as the “schizotypal signs” symptom dimension.

The second factor mostly included the first four items of the SCL dimension “psychoticism” — delusions of

control, auditory hallucinations, thought-broadcasting and thought-intrusion, and thus represents attenuated forms of the nuclear symptoms of schizophrenia. It will hereafter be referred to as the “schizophrenia nuclear symptoms” dimension. The remaining items of the original psychoticism dimension could not be assigned consistently and were excluded from further analyses. Sum scores were calculated to represent the individual values for the new symptom dimensions at each interview.

3.3. Cluster analysis identifying longitudinal patterns

Cluster analyses integrating sum scores of all interviews served to determine their typical longitudinal patterns over 20 years. The following patterns were common for both symptom dimensions “schizophrenia nuclear symptoms” (see Fig. 2) and “schizotypal signs” (see Fig. 3): (1) continuously high symptom load, (2) initially high symptom load with distinct decline and (3) constant low symptom load. The dimension “schizotypal signs” showed an additional pattern (4) with constant symptom load on a moderate level.

The prevalence of the pattern “continuously high symptom load” in the general population (corrected for

Table 2

Consecutive factor analyses with Promax-rotation on items from the paranoid ideation and psychoticism symptom dimensions of the SCL90-R; analyses restricted to 2 factors in each interview; factor loadings >0.5 are shown, loadings >0.6 are formatted bold

Psychoticism items in SCL90-R	Year		1981		1986		1988		1993		1999		
	Age		22/23		28/29		30/31		35/36		40/41		
	Factor	F1	F2	F1	F2	F1	F2	F1	F2	F1	F2	F1	F2
Feeling others are to blame for your troubles		0.50		0.60				0.54		0.57		0.56	
Feeling that most people cannot be trusted		0.61		0.62		0.66		0.63		0.78		0.73	
Feeling that you are watched by others		0.57		0.70		0.53		0.50	0.55	0.67		0.64	0.51
Having ideas that other do not share		0.60		0.55		0.66		0.54		0.61		0.61	
Others not giving you proper credit		0.69		0.62		0.70		0.58		0.71		0.71	
Feeling that people take advantage of you		0.54	0.57	0.77		0.65	0.50	0.70		0.77		0.67	
Someone else can control your thoughts			0.61		0.66		0.71		0.58		0.65		0.61
Hearing voices other people don't hear			0.67		0.65				0.64		0.60		
Other people being aware of your private thoughts			0.63				0.66		0.77		0.54		0.74
Having thoughts that are not your own			0.62		0.73		0.75		0.66		0.79		0.75
Feeling lonely even when with people		0.73		0.73		0.73		0.70		0.70		0.74	
Thoughts about sex that bother you		0.59		0.54		0.51		0.56			0.51		
The idea that you should be punished for sins					0.62								0.51
The idea that something is wrong with your body		0.56		0.60				0.60					
Never feeling close to another person		0.68		0.60		0.69		0.66		0.60		0.63	
The idea that something is wrong with your mind			0.61		0.55	0.55		0.55			0.60		0.63

the 1978 baseline weighting of the sample) was 5.8% for “schizophrenia nuclear symptoms” and 2.8% for “schizotypal signs”. In addition, 1.7% of the general population showed a continuously high symptom load for both dimensions simultaneously. The pattern “drop from high to low symptom load” was found in 13.9% and 8.0% respectively of the general population and the pattern “continuously low symptom load” was found in 80.3% and 70.1%, respectively. The pattern “moderate

symptom load” from the symptom dimension “schizotypal signs” accounted for 19.0% of the general population.

Six out of ten persons with a consistently high symptom load on “schizotypal signs” also displayed a continuously high symptom load of “schizophrenia nuclear symptoms”. A smaller proportion (<30%) of persons with a continuously high symptom load of “schizophrenia nuclear symptoms” also showed a con-

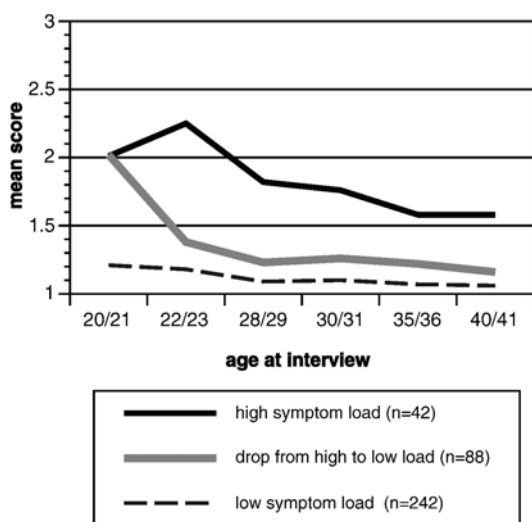


Fig. 2. Cluster analysis of the “schizophrenia nuclear symptoms” dimension over 6 interviews of the Zurich Study; cluster centers represent mean scores.

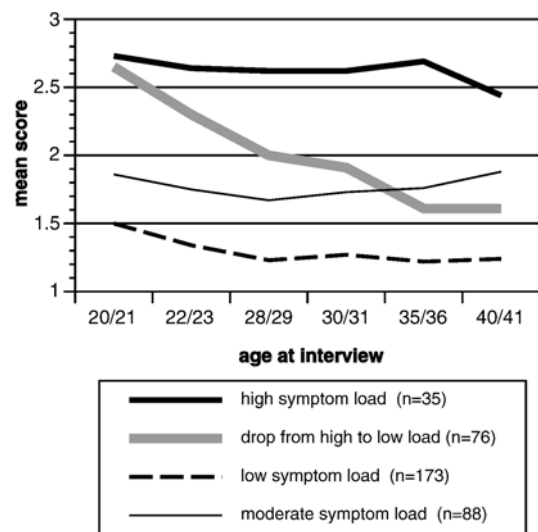


Fig. 3. Cluster analysis of the “schizotypal signs” symptom dimension over 6 interviews of the Zurich Study; cluster centers represent mean scores.

tinuously high symptom load on “schizotypal signs”. A bigger proportion of those persons with a continuously high symptom load of “schizophrenia nuclear symptoms” had additionally a continuously moderate symptom load with “schizotypal signs” thus indicating at least a certain degree of interpersonal problems.

Even though the newly identified symptom dimensions were moderately correlated (Cramer’s $V=0.39$), polytomous logistic regressions revealed a different pattern of predictors and correlates for each (see Tables 3 and 4). Cannabis use was the major factor in differentiating between a “continuously high symptom load” and a “continuously low symptom load” of “schizophrenia nuclear symptoms”. The odds ratios were higher for high cannabis use than for occasional cannabis use (ORs 4.3 vs. 2.3). The use of LSD/hallucinogens (OR=3.6) and discipline problems in school (OR=3.0) discriminated between “drop from high to low symptom load” and “continuously low symptom load”.

The symptom dimension “schizotypal signs” was associated with more potential predictors and correlates than “schizophrenia nuclear symptoms”. Most of these variables indicated deficiencies in social achievement and functioning and lower levels of family resilience. Thus, parental neglect, conflicts among and with parents, father’s mental illness, but also having been “punished more severely than other children” and having been “an unpopular mate” were significantly associated with pattern 1 (“continuously high symptom load”) of the symptom dimension “schizotypal signs”.

3.4. Social outcomes

The analyses focusing on social achievement and functioning (see Tables 5 and 6) indicated that persons who remained at a high symptomatic level over 20 years on “schizophrenia nuclear symptoms” or “schizotypal signs”, encountered significantly more difficulties in their lives. The spectrum of problems was similar in both the groups with a continuously high symptom load and concerned partnership, professional career as well as difficulties with the police.

4. Discussion

The hypothesized existence of psychotic spectrum features in the general population has recently attracted much research effort (Eaton et al., 1991; Johns et al., 2004; Kendler et al., 1996; van Os et al., 2000). However, little knowledge exists on how this phenotype persists or changes over the life span. This is the first longitudinal study to present data concerning psychotic experiences in the general population with regular assessments over a period of 20 years.

4.1. The psychosis continuum

Comparable to other studies, we found high rates of psychotic symptoms in the general population. A remarkable proportion of our cohort endorsed statements referring to symptoms which are usually thought to

Table 3
Consecutive polytomous logistic regressions on clusters from the “schizophrenia nuclear symptoms” dimension

RF variable in the analysis		Wald statistics	Signif.	OR	95% CI
Cluster		Statistics			
Cannabis 1979 (weekly or more)					
Continuous high level	yes vs. no	5.20	0.023	4.3	1.3–15.3
Change from high to low level		2.95	0.086	2.7	0.9–8.3
Continuous low level		–	–	1.0	
Cannabis 1979 (12 month prevalence)					
Continuous high level	yes vs. no	4.53	0.033	2.3	1.1–5.0
Change from high to low level		4.46	0.035	1.9	1.0–3.6
Continuous low level		–	–	1.0	
LSD/hallucinogens 1979					
Continuous high level	yes vs. no	1.39	0.238	2.4	0.6–10.3
Change from high to low level		5.39	0.020	3.6	1.2–10.5
Continuous low level		–	–	1.0	
Discipline problems in school (youth)					
Continuous high level	yes vs. no	2.75	0.097	2.2	0.9–5.6
Change from high to low level		9.30	0.002	3.0	1.4–6.1
Continuous low level		–	–	1.0	

Odds ratios refer to cluster 1 (“continuous high level” ($n=42$, 11.3%)) and cluster 2 (“change from high to low level” ($n=88$, 23.7%)). The baseline category is the cluster 3 (“continuous low level” ($n=242$, 65.1%)). Each analysis was adjusted for gender and 1978-baseline high- vs. low-scorer-status on SCL90-R; only results for predictors are shown (results for gender and 1978 baseline high- vs. low-scorer-status were suppressed).

Table 4
Consecutive polytomous logistic regressions on clusters from the “schizotypal signs” dimension

RF variable in the analysis		Wald statistics	Signif.	OR	95% CI
Cluster		Statistics			
Marital status of parents					
Continuous high level	not vs. married	7.25	0.007	4.2	1.5–11.7
Change from high to low level	not vs. married	2.62	0.106	2.1	0.8–5.4
Continuous medium level	not vs. married	0.12	0.726	0.8	0.3–2.3
Continuous low level		–	–	1.0	
Parents had chronically physical or mental problems (childhood/youth)					
Continuous high level	yes vs. no	10.70	0.001	4.0	1.8–9.4
Change from high to low level	yes vs. no	3.98	0.046	1.8	1.0–3.5
Continuous medium level	yes vs. no	3.19	0.074	1.6	0.9–2.9
Continuous low level		–	–	1.0	
Father had mental problems or was under treatment (childhood/youth)					
Continuous high level	yes vs. no	7.23	0.007	3.3	1.4–8.0
Change from high to low level	yes vs. no	1.13	0.287	1.5	0.7–3.3
Continuous medium level	yes vs. no	1.18	0.278	0.6	0.3–1.5
Continuous low level		–	–	1.0	
Mother had physical problems or was disabled (childhood/youth)					
Continuous high level	yes vs. no	2.33	0.127	2.5	0.8–8.7
Change from high to low level	yes vs. no	6.99	0.008	3.6	1.4–9.5
Continuous medium level	yes vs. no	4.61	0.032	2.6	1.1–6.4
Continuous low level		–	–	1.0	
Parents quarreled a lot (childhood/youth)					
Continuous high level	yes vs. no	9.24	0.002	3.5	1.6–7.9
Change from high to low level	yes vs. no	5.37	0.020	2.1	1.2–4.2
Continuous medium level	yes vs. no	1.55	0.213	1.4	0.8–2.7
Continuous low level		–	–	1.0	
Serious conflicts with parents (childhood/youth)					
Continuous high level	yes vs. no	5.07	0.024	2.4	1.1–5.5
Change from high to low level	yes vs. no	0.03	0.851	1.0	0.6–2.0
Continuous medium level	yes vs. no	0.12	0.730	0.9	0.5–1.6
Continuous low level		–	–	1.0	
Parents were neglectful (childhood/youth)					
Continuous high level	yes vs. no	18.19	0.000	6.7	2.8–16.3
Change from high to low level	yes vs. no	12.54	0.000	3.8	1.8–8.0
Continuous medium level	yes vs. no	0.67	0.414	1.3	0.6–2.9
Continuous low level		–	–	1.0	
Punished more severely than others (childhood/youth)					
Continuous high level	yes vs. no	6.34	0.012	3.1	1.3–7.8
Change from high to low level	yes vs. no	0.57	0.450	1.3	0.6–3.1
Continuous medium level	yes vs. no	3.61	0.057	2.0	0.9–4.1
Continuous low level		–	–	1.0	
Unpopular mate (youth)					
Continuous high level	yes vs. no	8.23	0.004	3.6	1.5–9.0
Change from high to low level	yes vs. no	0.62	0.431	1.3	0.6–3.2
Continuous medium level	yes vs. no	0.87	0.351	1.4	0.6–3.1
Continuous low level		–	–	1.0	

Odds ratios refer to cluster 1 (“continuous high level” ($n=35$, 9.4%)), cluster 2 (“change from high to low level” ($n=76$, 20.4%)) and cluster 3 (“continuous moderate level” ($n=88$, 23.7%)). The baseline category is the cluster 4 (“continuous low level” ($n=173$, 46.5%)). Each analysis was adjusted for gender and 1978-baseline high- vs. low-scorer-status on SCL90-R; only results for predictors are shown (results for gender and 1978 baseline high- vs. low-scorer-status were suppressed).

belong to the core symptoms of psychotic disorders such as “others being aware of your thoughts”, “having thoughts that are not your own” or “someone else can control your thoughts”. Such statements can be separated from para-psychological beliefs (e.g. concerning thought-

transference between people) (Cox and Cowling, 1989), on the basis that the persons interviewed in our cohort were not agreeing with general statements but referred to themselves only (Johns et al., 2004; Kendler et al., 1996; Poulton et al., 2000; van Os et al., 2000). Nevertheless,

Table 5

Life events over several interviews and clusters from the “schizophrenia nuclear symptoms” dimension: results from GEE analyses using an exchangeable correlation structure and adjusting for time

	Cluster	OR	95% CI	Z	Prob
Degradation in job ^a 1979–99	Continuous high level	7.3	2.0–26.0	3.06	0.002
	Change from high to low level	4.1	1.2–14.2	2.24	0.025
	Continuous low level	1.0	–	–	–
Financial problems 1979–88	Continuous high level	2.2	1.1–4.3	2.37	0.018
	Change from high to low level	1.3	0.8–2.1	0.89	0.373
	Continuous low level	1.0	–	–	–
Minor problems with police 1979–99	Continuous high level	2.3	1.3–4.3	2.70	0.007
	Change from high to low level	1.4	0.7–2.6	0.99	0.325
	Continuous low level	1.0	–	–	–
Imprisonment ^a 1979–99	Continuous high level	24.0	2.7–209.5	2.87	0.004
	Change from high to low level	8.1	0.9–76.8	1.82	0.068
	Continuous low level	1.0	–	–	–
Increasing problems with partner 1979–99	Continuous high level	1.6	1.1–2.3	2.56	0.011
	Change from high to low level	1.1	0.8–1.4	0.43	0.670
	Continuous low level	1.0	–	–	–

^a Poisson distribution with log link function used instead of binomial distribution with logit link function.

these statements do not generally reflect illness as most persons reporting such symptoms rated associated distress as “a little bit”. Although not clinical in nature, however, there is evidence that spectrum symptoms as described in the current study co-vary in community samples with neurocognitive alterations (Krabbendam et al., 2005; Tien et al., 1992).

The data support the notion of continuity of psychotic symptoms with normal experiences. Dichotomous psychosis categories (i.e. the great majority of the population has negligible values whereas a very small proportion has extremely high values) would be the result of one single cause such as one gene responsible for the occurrence of psychosis. However, a multifactorial etiology including a polygenic threshold model is much more consistent with the idea that psychotic symptoms occur with an approximately normal distribution in the general population (Johns and van Os, 2001). Actually, a half normal distribution with the majority of the respondents having zero-values but a considerable part having non-zero values with increasing intensity was found in the current sample.

4.2. Course and stability

From the single-item analysis the course of psychotic spectrum features is quite variable in the general population, as described by Hanssen et al. (2005). As in all studies examining the effect of age in relation to both

clinical and subclinical psychosis (Verdoux and van Os, 2002; Verdoux et al., 1998b), there was a strong tendency for such symptoms to decrease with age. From the epidemiology of schizophrenia and psychotic disorders we would expect the highest rates of psychotic symptoms to occur in the twenties with a constant decline over the two decades of our observation period. For most items of the SCL90-R this is actually the case in our cohort.

4.3. Differentiation of symptom dimensions

The dimension “schizophrenia nuclear symptoms” brings together milder versions of the core diagnostic symptoms of psychosis and was consistently replicable in cross-sectional as well as longitudinal analyses of the SCL90-R items. This was also true for the dimension “schizotypal signs” which comes quite close to the required diagnostic criteria of the DSM-IV for schizotypal personality disorder. It is characterized by generalized distrust, odd interpersonal beliefs and paranoid ideation.

The results indicate a relatively high overlap of the two dimensions on a psychopathological level. However, the two symptom dimensions coincided only partly.

4.4. Predictors

The clearest evidence for two distinct dimensions comes from their differential pattern of associations with predictors. Use of cannabis at age 20/21 was the most

Table 6

Life events over several interviews and clusters from the “schizotypal signs” dimension: results from GEE analyses using an exchangeable correlation structure and adjusting for time

	Cluster	OR	95% CI	Z	Prob
Conflicts at the place of work 1979–99	Continuous high level	2.5	1.9–3.6	4.69	<0.0001
	Change from high to low level	1.7	1.2–2.3	3.28	0.001
	Continuous medium level	1.5	1.1–2.0	2.35	0.019
	Continuous low level	1.0	–	–	–
Discharge from work 1979–99	Continuous high level	4.0	1.9–8.3	3.68	0.000
	Change from high to low level	0.9	0.3–2.3	–0.25	0.804
	Continuous medium level	1.2	0.5–2.7	0.40	0.692
	Continuous low level	1.0	–	–	–
Unemployment 1979–99	Continuous high level	3.2	1.5–7.0	3.00	0.003
	Change from high to low level	1.7	0.8–3.7	1.47	0.143
	Continuous medium level	1.5	0.7–2.9	1.04	0.297
	Continuous low level	1.0	–	–	–
Minor problems with police 1979–99	Continuous high level	2.5	1.1–5.5	2.27	0.023
	Change from high to low level	1.2	0.6–2.2	0.51	0.611
	Continuous medium level	1.4	0.7–2.6	1.02	0.306
	Continuous low level	1.0	–	–	–
Major problems with police 1979–99	Continuous high level	3.6	1.3–9.7	2.53	0.012
	Change from high to low level	0.7	0.2–2.3	–0.52	0.606
	Continuous medium level	0.6	0.2–2.0	–0.81	0.420
	Continuous low level	1.0	–	–	–
Imprisonment ^a 1979–99	Continuous high level	15.2	1.6–140.7	2.39	0.017
	Change from high to low level	7.1	0.7–66.5	1.71	0.088
	Continuous medium level	1.9	0.1–30.3	0.46	0.643
	Continuous low level	1.0	–	–	–
Conflicts with other person in the household 1979–99	Continuous high level	2.2	1.3–3.6	3.13	0.002
	Change from high to low level	1.5	1.0–2.2	2.02	0.044
	Continuous medium level	1.3	0.9–1.8	1.44	0.149
	Continuous low level	1.0	–	–	–
Increasing problems with partner 1979–99	Continuous high level	2.6	1.8–3.9	4.72	<0.0001
	Change from high to low level	1.4	1.0–1.9	1.87	0.062
	Continuous medium level	1.4	1.0–2.0	2.10	0.036
	Continuous low level	1.0	–	–	–
Separation from partner 1979–99	Continuous high level	2.1	1.3–3.2	3.20	0.001
	Change from high to low level	1.8	1.2–2.7	2.95	0.003
	Continuous medium level	1.2	0.8–1.9	0.84	0.398
	Continuous low level	1.0	–	–	–
Left by partner 1981–99	Continuous high level	2.5	1.2–5.2	2.55	0.011
	Change from high to low level	1.1	0.5–2.3	0.20	0.838
	Continuous medium level	1.6	0.9–3.0	1.61	0.107
	Continuous low level	1.0	–	–	–

^a Poisson distribution with log link function used instead of binomial distribution with logit link function.

prominent predictor for a continuously high symptom load of “schizophrenia nuclear symptoms” over the next 20 years. The odds ratios were higher in frequent users thus indicating a dose–response relationship.

The results are in line with recent literature. Cannabis has been discussed as a predictor for psychotic disorders since the end of the 1980s. In meta-analyses, the odds ratio for the risk of schizophrenia in cannabis users was

shown to be slightly above 2 after adjustment for potential confounders (Arseneault et al., 2004; Henquet et al., 2005b). Prospective studies have unambiguously shown that cannabis use is a precursor of psychotic disorders and that its effect goes beyond transient intoxication (Arseneault et al., 2002; Fergusson et al., 2005; Fergusson et al., 2003; Henquet et al., 2005a; van Os et al., 2002; Zammit and Lewis, 2004). While cannabis use seems to be specific for a high symptom load of “schizophrenia nuclear symptoms”, the symptom dimension “schizotypal signs” was associated with different predictors related to interpersonal conflicts, neglect and punishment in childhood and youth. The common denominator might be described as early social adversity. Associations with early social adversity had been shown for various mental disorders (Goldstein and Rodnick, 1975; Kessler et al., 1997) and more recently associations between early social circumstances and psychotic disorders have been demonstrated. Thus, there has been a revival of studies on ecological variables such as growing up in an urban environment and migration which are associated with an increased risk of schizophrenia (Broome et al., 2005; Sundquist et al., 2004; van Os, 2004; Wessely et al., 1991). Secondly, recent work has suggested childhood trauma and victimization (Bak et al., 2005; Bebbington et al., 2004) may also be related to increased risk for schizophrenia. In addition, adversity in the sense of chronic subthreshold adversity in everyday life, for example, exposure to continuous conflicts and unpleasant circumstances in the family, may be associated with later schizophrenia. Thus, the Finnish study of adopted-away children of mothers with schizophrenia demonstrated an interaction effect between low resilience in adoptive families and genetic risk for schizophrenia (Tienari et al., 2004).

The differentiation of predictors for each symptom dimension yields a major implication, as the differential pattern of risk supports the validity of our empirically generated symptom dimensions and makes it plausible that the symptom dimension “schizophrenia nuclear symptoms” and the symptom dimension “schizotypal signs” represent partly different etiological dimensions. The overlap of these dimensions requires a new interpretative approach, which more clearly defines the interplay of biological and psychosocial pathways to the manifestation of psychotic disorders.

4.5. Deficiencies in social achievement and functioning

In contrast to the sharply different predictor profiles associated with the two dimensions, both dimensions

are associated with similar negative social consequences, with the symptom dimension “schizotypal signs” displaying a stronger association with interpersonal problems. In both dimensions, individuals with a continuously high symptom load showed a significant association with various kinds of functional impairments, thus contradicting the view that subclinical psychotic features are without clinical relevance.

4.6. Strengths and limitations of the study

Most studies dealing with psychotic experiences in the general population have hitherto relied on cross-sectional analyses. The prospective design of our study, which covers a time period of 20 years and six cross-sectional interviews, allowed for a more detailed analysis of causes and consequences. Our cohort was also passing through the period of onset and persistence of major psychotic disorders, i.e., the period between 20 and 40 years of age (Angst et al., 2005).

However, self-rating scales as the SCL90-R may be insufficient as they rely exclusively on the individuals' ability to accurately describe their condition. Reliable reports may be doubtful at times, e.g. because of denial, minimization of symptoms, or responder bias (Eisen et al., 1999). Not all symptoms as required either in DSM-IV or ICD-10 for a diagnosis of schizophrenia and other psychotic disorders or schizotypal personality disorders could be included, as they are not all part of the SCL90-R. Further limitations of the study are the increasing attrition rate across 20 years, and the relatively small sample size of this cohort. Lastly, transition rates of individuals with early psychotic experiences to manifest psychotic disorders could not be calculated.

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References

- Angst, J., Dobler-Mikola, A., Binder, J., 1984. The Zurich study—A prospective epidemiological study of depressive, neurotic and psychosomatic syndromes: I. Problem, methodology. *Eur. Arch. Psychiatr. Neurol. Sci.* 234, 13–20.
- Angst, J., Gamma, A., Neuenschwander, M., Ajdacic-Gross, V., Eich, D., Rössler, W., Merikangas, K.R., 2005. Prevalence of mental disorders in the Zurich Cohort Study: a twenty year prospective study. *Epidemiol. Psychiatr. Soc.* 14, 68–76.
- Arseneault, L., Cannon, M., Poulton, R., Murray, R., Caspi, A., Moffitt, T.E., 2002. Cannabis use in adolescence and risk for adult psychosis: longitudinal prospective study. *BMJ* 325, 1212–1213.

- Arseneault, L., Cannon, M., Witton, J., Murray, R.M., 2004. Causal association between cannabis and psychosis: examination of the evidence. *Br. J. Psychiatry* 184, 110–117.
- Bak, M., Krabbendam, L., Janssen, I., de Graaf, R., Vollebergh, W., van Os, J., 2005. Early trauma may increase the risk for psychotic experiences by impacting on emotional response and perception of control. *Acta Psychiatr. Scand.* 112, 360–366.
- Bebbington, P.E., Bhugra, D., Brugha, T., Singleton, N., Farrell, M., Jenkins, R., Lewis, G., Meltzer, H., 2004. Psychosis, victimisation and childhood disadvantage: evidence from the second British National Survey of Psychiatric Morbidity. *Br. J. Psychiatry* 185, 220–226.
- Broome, M.R., Woolley, J.B., Tabraham, P., Johns, L.C., Bramon, E., Murray, G.K., Pariante, C., McGuire, P.K., Murray, R.M., 2005. What causes the onset of psychosis? *Schizophr. Res.* 79, 23–34.
- Chapman, L.J., Chapman, J.P., Kwapil, T.R., Eckblad, M., Zinser, M.C., 1994. Putatively psychosis-prone subjects 10 years later. *J. Abnorm. Psychol.* 103, 171–183.
- Cox, D., Cowling, P., 1989. *Are You Normal?*. Tower Press, London.
- Derogatis, L.R., 1977. SCL-90. Administration, Scoring and Procedures Manual-1 for the R (revised) Version and Other Instruments of the Psychopathology Rating Scale Series., Chicago.
- Derogatis, L.R., Cleary, P.A., 1977. Confirmation of the dimensional structure of the SCL-90: a study in construct validity. *J. Clin. Psychol.* 33, 981–989.
- Derogatis, L.R., Melisaratos, N., 1983. The brief symptom inventory: an introductory report. *Psychol. Med.* 13, 595–605.
- Dunn, G., Pickles, A., Tansella, M., Vazquez-Barquero, J.L., 1999. Two-phase epidemiological surveys in psychiatric research. *Br. J. Psychiatry* 174, 95–100.
- Eaton, W.W., Romanoski, A., Anthony, J.C., Nestadt, G., 1991. Screening for psychosis in the general population with a self-report interview. *J. Nerv. Ment. Dis.* 179, 689–693.
- Eich, D., Ajdacic-Gross, V., Condrau, M., Huber, H., Gamma, A., Angst, J., Rössler, W., 2003. The Zurich study: participation patterns and Symptom Checklist 90-R scores in six interviews, 1979–99. *Acta Psychiatr. Scand.* 108 (Suppl. 418), 11–14.
- Eisen, S.V., Leff, H.S., Schaefer, E., 1999. Implementing outcome systems: lessons from a test of the BASIS-32 and the SF-36. *J. Behav. Health Serv. Res.* 26, 18–27.
- Escher, S., Romme, M., Buiks, A., Delespaul, P., Van Os, J., 2002. Independent course of childhood auditory hallucinations: a sequential 3-year follow-up study. *Br. J. Psychiatry Suppl* 43, s10–s18.
- Everitt, B.S., 1993. *Cluster Analysis*. Arnold, London.
- Fergusson, D.M., Horwood, L.J., Swain-Campbell, N.R., 2003. Cannabis dependence and psychotic symptoms in young people. *Psychol. Med.* 33, 15–21.
- Fergusson, D.M., Horwood, L.J., Ridder, E.M., 2005. Tests of causal linkages between cannabis use and psychotic symptoms. *Addiction* 100, 354–366.
- Goldstein, M.J., Rodnick, E.H., 1975. The family's contribution to the etiology of schizophrenia: current status. *Schizophr. Bull.* 14, 48–63.
- Hafkenscheid, A., 1993. Psychometric evaluation of the Symptom Checklist (SCL-90) in psychiatric patients. *Pers. Individ. Differ.* 14, 751–756.
- Hanssen, M., Bak, M., Bijl, R., Vollebergh, W., van Os, J., 2005. The incidence and outcome of subclinical psychotic experiences in the general population. *Br. J. Clin. Psychol.* 44, 181–191.
- Harrington, R., Fudge, H., Rutter, M., Pickles, A., Hill, J., 1990. Adult outcomes of childhood and adolescent depression. I. Psychiatric status. *Arch. Gen. Psychiatry* 47, 465–473.
- Henquet, C., Krabbendam, L., Spauwen, J., Kaplan, C., Lieb, R., Wittchen, H.U., van Os, J., 2005a. Prospective cohort study of cannabis use, predisposition for psychosis, and psychotic symptoms in young people. *BMJ* 330, 11.
- Henquet, C., Murray, R., Linszen, D., van Os, J., 2005b. The environment and schizophrenia: the role of cannabis use. *Schizophr. Bull.* 31, 608–612.
- Holmes, T.H., Rahe, R.H., 1967. The Social Readjustment Rating Scale. *J. Psychosom. Res.* 11, 213–218.
- Johns, L.C., van Os, J., 2001. The continuity of psychotic experiences in the general population. *Clin. Psychol. Rev.* 21, 1125–1141.
- Johns, L.C., Nazroo, J.Y., Bebbington, P., Kuipers, E., 2002. Occurrence of hallucinatory experiences in a community sample and ethnic variations. *Br. J. Psychiatry* 180, 174–178.
- Johns, L.C., Cannon, M., Singleton, N., Murray, R.M., Farrell, M., Brugha, T., Bebbington, P., Jenkins, R., Meltzer, H., 2004. Prevalence and correlates of self-reported psychotic symptoms in the British population. *Br. J. Psychiatry* 185, 298–305.
- Kendler, K.S., Gallagher, T.J., Abelson, J.M., Kessler, R.C., 1996. Lifetime prevalence, demographic risk factors, and diagnostic validity of nonaffective psychosis as assessed in a US community sample. The National Comorbidity Survey. *Arch. Gen. Psychiatry* 53, 1022–1031.
- Kessler, R.C., Davis, C.G., Kendler, K.S., 1997. Childhood adversity and adult psychiatric disorder in the US National Comorbidity Survey. *Psychol. Med.* 27, 1101–1119.
- Krabbendam, L., Arts, B., van Os, J., Aleman, A., 2005. Cognitive functioning in patients with schizophrenia and bipolar disorder: a quantitative review. *Schizophr. Res.* 80, 137–149.
- Lewis-Beck, M.S., 1994. *Factor Analysis and Related Techniques*. Sage, London.
- Merikangas, K.R., Zhang, H., Avenevoli, S., Acharyya, S., Neuwander, M., Angst, J., 2003. Longitudinal trajectories of depression and anxiety in a prospective community study: the Zurich Cohort Study. *Arch. Gen. Psychiatry* 60, 993–1000.
- Olsen, L.R., Mortensen, E.L., Bech, P., 2004. The SCL-90 and SCL-90R versions validated by item response models in a Danish community sample. *Acta Psychiatr. Scand.* 110, 225–229.
- Poulton, R., Caspi, A., Moffitt, T.E., Cannon, M., Murray, R., Harrington, H., 2000. Children's self-reported psychotic symptoms and adult schizophreniform disorder: a 15-year longitudinal study. *Arch. Gen. Psychiatry* 57, 1053–1058.
- Schmitz, N., Hartkamp, N., Franke, G.H., 2000. Assessing clinically significant change: application to the SCL-90-R. *Psychol. Rep.* 86, 263–274.
- Spauwen, J., Krabbendam, L., Lieb, R., Wittchen, H.U., van Os, J., 2003. Sex differences in psychosis: normal or pathological? *Schizophr. Res.* 62, 45–49.
- Sundquist, K., Frank, G., Sundquist, J., 2004. Urbanisation and incidence of psychosis and depression: follow-up study of 4.4 million women and men in Sweden. *Br. J. Psychiatry* 184, 293–298.
- Tennant, C., Andrews, G., 1976. A scale to measure the stress of life events. *Aust. N. Z. J. Psychiatry* 10, 27–32.
- Tien, A.Y., 1991. Distributions of hallucinations in the population. *Soc. Psychiatry Psychiatr. Epidemiol.* 26, 287–292.
- Tien, A.Y., Costa, P.T., Eaton, W.W., 1992. Covariance of personality, neurocognition, and schizophrenia spectrum traits in the community. *Schizophr. Res.* 7, 149–158.
- Tienari, P., Wynne, L.C., Sorri, A., Lahti, I., Laksy, K., Moring, J., Naarala, M., Nieminen, P., Wahlberg, K.E., 2004. Genotype-environment interaction in schizophrenia-spectrum disorder. Long-

- term follow-up study of Finnish adoptees. *Br. J. Psychiatry* 184, 216–222.
- Twisk, J.W.R., 2003. *Applied Longitudinal Data Analysis for Epidemiology*. Cambridge University Press, Cambridge.
- van Os, J., 2004. Does the urban environment cause psychosis? *Br. J. Psychiatry* 184, 287–288.
- van Os, J., Hanssen, M., Bijl, R.V., Ravelli, A., 2000. Strauss (1969) revisited: a psychosis continuum in the general population? *Schizophr. Res.* 45, 11–20.
- van Os, J., Bak, M., Hanssen, M., Bijl, R.V., de Graaf, R., Verdoux, H., 2002. Cannabis use and psychosis: a longitudinal population-based study. *Am. J. Epidemiol.* 156, 319–327.
- Verdoux, H., van Os, J., 2002. Psychotic symptoms in non-clinical populations and the continuum of psychosis. *Schizophr. Res.* 54, 59–65.
- Verdoux, H., Maurice-Tison, S., Gay, B., Van Os, J., Salamon, R., Bourgeois, M.L., 1998a. A survey of delusional ideation in primary-care patients. *Psychol. Med.* 28, 127–134.
- Verdoux, H., van Os, J., Maurice-Tison, S., Gay, B., Salamon, R., Bourgeois, M., 1998b. Is early adulthood a critical developmental stage for psychosis proneness? A survey of delusional ideation in normal subjects. *Schizophr. Res.* 29, 247–254.
- Wessely, S., Castle, D., Der, G., Murray, R., 1991. Schizophrenia and Afro-Caribbeans. A case-control study. *Br. J. Psychiatry* 159, 795–801.
- Zammit, S., Lewis, G., 2004. Exploring the relationship between cannabis use and psychosis. *Addiction* 99, 1353–1355.