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Prevalence, incidence, and persistence of psychotic experiences in the general population: results of a 9-year follow-up study‡

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Abstract

Background. Psychotic experiences (PEs) frequently occur and are associated with a range of negative health outcomes. Prospective studies on PEs are scarce, and to date no study investigated PE prevalence, incidence, persistence, their risk indicators, and psychiatric comorbidity, in one dataset. Furthermore, most studies are based on self-report, and it is unclear how this compares to clinical interviews.

Methods. Data are used from the Netherlands Mental Health Survey and Incidence Study-2 (NEMESIS-2), a psychiatric cohort study among a representative sample of adults (baseline characteristics: $N = 6646$; 49.6% female; 18–64 years). Results are presented for self-reported and clinically validated PEs. Associations are assessed for mental disorders, socio-demographic, vulnerability, physical health, and substance use factors.

Results. Based on self-report, at baseline 16.5% of respondents had at least one PE in their lifetime, of those, 30.1% also reported a PE at 3-year follow-up. 4.8% had a first PE at 3-year follow up. The 3-year prevalence of PE was associated with almost all studied risk indicators. Generally, the strongest associations were found for mental health disorders. Prevalence and incidence rates were two to three times higher in self-report than in clinical interview but results on associated factors were similar.

Conclusions. Validated prevalence and incidence estimates of PE are substantially lower than self-reported figures but results on associated factors were similar. Therefore, future studies on associations of PEs can rely on relatively inexpensive self-reports of PEs. The associations between PE and mental disorders underline the importance of assessment of PE in general practice.

Introduction

Psychotic experiences (PEs) comprise hallucinations and delusions. (Linscott & Van Os, 2013). PEs frequently occur and increase the risk of progression to psychotic disorder (Kaymaz et al., 2012; Linscott & Van Os, 2013; Werbeloff et al., 2012), and other mental disorders (Fisher, 2013; Kırlı et al., 2019a; McGrath et al., 2016; Werbeloff et al., 2012). Moreover, PEs are associated with the onset of a wide range of physical disorders (Scott et al., 2018), disability (Navarro-Mateu et al., 2017), poor perceived mental and physical health (Alonso et al., 2019), significant deficiencies in social achievement and functioning (Rössler et al., 2007), self-injurious behaviour (Honings, Drukker, Groen, & Van Os, 2016), and onset of suicidal thoughts and behaviours (Bromet et al., 2017). These findings stress the impact PEs may have on the individual and society.

A systematic review and meta-analysis on PE in children and adults found a lifetime prevalence of 7.2%, based on 61 surveys, mainly conducted in Western countries (Linscott & Van Os, 2013). Results of the World Mental Health (WMH) Surveys, including 18 Western and non-Western countries, and not included in abovementioned systematic review, showed an average lifetime prevalence of 5.8% and a last year prevalence of 2.0% among adults (McGrath et al., 2015). Only a few studies reported incidence rates of PEs in the general population; based on six cohorts Linscott and Van Os (2013) estimated the median annual incidence at 2.5%. Although results of the few existing prospective studies indicate that PEs are mostly a transitory phenomenon, for some people PEs persist over time. In their review, based on four cohorts (one each in

Great Britain and Germany and two in the Netherlands) with intervals spanning 1–8 years, Linscott and Van Os (2013) estimated the PE persistence rate at approximately 20%. A study published after this review, reported a persistence rate of 15.1% at 2-year follow-up among adults in Hong Kong (Chan et al., 2020). Another survey, performed in the United States, reported a 12-month persistence rate of 28.1%, but this was assessed retrospectively (DeVylder, Lehmann, & Chen, 2015).

Risk indicators

Cross-sectional studies have shown that PEs are associated with several risk indicators. The WMH Surveys found evidence for demographic correlates, including female sex, non-married, non-employed (McGrath et al., 2015), and living in a non-rural area (Scott, Chant, Andrews, & McGrath, 2006), prior common mental disorders (McGrath et al., 2016), vulnerability factors, including childhood adversities (McGrath et al., 2017a), childhood physical neglect (Stickley et al., 2021) and traumatic events in adulthood (McGrath et al., 2017b). Less evidence was found for prior physical disorders (Scott et al., 2018). Cross-sectional data of the NESARC study retrospectively confirmed the WMH Survey findings with respect to the abovementioned demographic correlates and additionally found younger age, low family income, lifetime history of suicide attempts (Bourgin et al., 2020), and smoking (Mallet, Mazer, Dubertret, & Strat, 2018) as correlates. Other studies have reported on cross-sectional associations of PEs with cannabis use (Ragazzi, Shuhama, Menezes, & Del-Ben, 2018), daily smoking, alcohol dependence, cannabis dependence (Saha et al., 2011a), bullying victimization (Catone et al., 2015), other mental disorders, including depressive, anxiety, bipolar and post-traumatic stress disorder (Pignon et al., 2018; Varghese et al., 2011b), family history of mental disorders (Varghese, Saha, Scott, Chan, & Mcgrath, 2011a), dementia (Ballard, 1995), and psychiatric/psychological or psychopharmacological treatment (Oh, Koyanagi, DeVylder, & Leiderman, 2020).

While risk indicators for PE prevalence seem reasonably well established, information on risk indicators of PE incidence is limited. The available literature from prospective studies shows that at least some risk indicators overlap with those associated with PE prevalence. These include demographic characteristics [younger age, lower educational level and non-married; (Kırlı et al., 2019a), childhood adversity (Bennett, Surkan, Moulton, Fombonne, & Melchior, 2020; Wiles et al., 2006), traumatic events (Spauwen, Krabbendam, Lieb, Wittchen, & Van Os, 2006), smoking, a harmful pattern of drinking (Wiles et al., 2006), bullying victimization (Catone et al., 2015), family history of mental disorders (Kirli et al., 2019b) and psychotropic medication use (Kırlı et al., 2019a). Living in a rural area, having a small support group, and neurotic symptoms (Wiles et al., 2006), are also reported as risk indicators for PE.

Studies reporting on predictors of the persistence of PE in the adult population are scarce, and one study was based on predictors of retrospectively assessed persistence (DeVylder et al., 2015). Several recent studies reported on the persistence of PEs among children and adolescents (e.g. Karcher et al., 2021; Steenkamp et al., 2021). However, since risk factors and expression of PE differs between this young age group and adults [e.g. (e.g. Stevens, Prince, Prager, and Stern, 2014)], the results of these studies are not further discussed in this paper. The set of risk indicators that has been identified for PE persistence in the adult population shows overlap with those for PE prevalence and incidence, i.e., younger age, non-married, lower education (DeVylder et al., 2015), childhood adversity (Rössler et al., 2007; Trotta, Murray, & Fisher, 2015), childhood trauma (Cougnard et al., 2007), parental chronic mental and physical disorders (Rössler et al., 2007), bullying victimization (Catone et al., 2015), cannabis use (Cougnard et al., 2007; Rössler et al., 2007), and urbanicity exposure (Cougnard et al., 2007). However, notable differences with risk indicators for PE prevalence were also reported. DeVylder et al. (2015) concluded that depressive, anxiety, and substance use disorders were not independently associated with PE persistence, although these disorders are common among individuals with PEs. It should be noted that these results were based on retrospectively assessed reports of PEs and therefore should be interpreted with caution Furthermore, living in an urban area appeared a risk indicator for PE prevalence (Van Os et al., 2001) and persistence (Cougnard et al., 2007), while living in a rural area was associated with a higher risk for incidence of PE (Wiles et al., 2006).

In conclusion, studying PEs and its predictors is relevant since PEs frequently occur and are associated with a wide range of adverse outcomes. The prevalence of PE and its risk indicators seem to be relatively well established. However, prospective studies on PEs are scarce which limits our knowledge on (predictors of) incident and persistent PE. More information is needed, especially on persistent PEs as associations between PEs and adverse outcomes, appear to be particularly strong for PEs that persist over time (Kalman, Bresnahan, Schulze, & Susser, 2019; Kirli et al., 2019b). The main aim of this study is to address two questions that are relevant for clinical practice. First, although, PEs are established indicators of clinical severity, to date there is no study that has investigated PE prevalence, incidence, persistence, its risk indicators, and psychiatric comorbidity in one dataset with multiple follow-ups over time. This information is essential to give PE the right clinical meaning in clinical assessment procedures in mental health care. Second, most epidemiological studies on PE are based on self-report, but it is not sufficiently clear how this compares to the results of clinical interviews. This is important information, also given the possibility of relatively inexpensive transdiagnostic screening in clinical practice.

The main aim of the present study is to address these gaps in the literature by reporting on prevalence, incidence, and persistence of PEs and a wide range of risk indicators in one study, the Netherlands Mental Health Survey and Incidence Study-2 (NEMESIS-2). All results are presented for both self-reported and clinically validated PEs. Associations with risk indicators are studied for 3-year prevalence, -incidence and -persistence. In line with the conceptualization of psychosis as an extended phenotype, we study the full range of psychotic symptom expression, i.e. not only the subthreshold phenotype [(Van Os & Reininghaus, 2016)].

Method

Materials and methods

NEMESIS-2 is a psychiatric epidemiological cohort study of the Dutch general population aged 18–64. It is based on a multistage, stratified random sampling of households, with one respondent randomly selected from each household. The face-to-face interviews were laptop computer assisted. In the first wave (T_0),

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performed from November 2007 to July 2009, 6646 individuals were interviewed (response rate 65.1%). This sample was nationally representative, although younger subjects were somewhat underrepresented (de Graaf, Ten Have, & van Dorsselaer, 2010).

All respondents were approached for follow-up, three years (T_1: $n = 5303$; response rate 80.4%, with those deceased excluded; duration), six years (T_2: $n = 4618$; response rate 87.8%) and nine years (T_3: $n = 4007$; response rate 87.7%) after baseline. Attrition between T_0 and T_3 was not significantly associated with PEs and all in the study assessed 12-month mental disorders at T_0 after controlling for sociodemographic characteristics (Nuyen et al., 2021).

The study was approved by a medical ethics committee (the Medical Ethics Review Committee for Institutions on Mental Health Care, METIGG). After receiving information about the study aims, respondents provided written informed consent at each wave. A comprehensive description of the design can be found elsewhere (de Graaf et al., 2010).

Diagnostic instrument

The Composite International Diagnostic Interview (CIDI) version 3.0 was used at all waves to assess DSM-IV mood, anxiety and substance use disorders, and suicidal thoughts. At baseline lifetime occurrence was assessed, at each follow-up wave 3-year interval occurrence. The CIDI 3.0 is a fully structured lay-administered interview developed by the World Health Organization (Kessler & Üstün, 2004). Clinical reappraisal interviews showed that it has generally good validity for assessing common mental disorders (Haro et al., 2006).

Psychotic experiences

Psychotic symptoms were assessed using a 20-item binary-response questionnaire based on the CIDI 1.1 and specifically developed for evaluating psychotic symptoms (Bijl, Van Zessen, Ravelli, De Rijk, & Langendoen, 1998) (see the appendix for a description of the items) At T_3, 7 very low frequent PEs were not assessed to limit respondent's interview burden, resulting in a 13-item questionnaire. At baseline, lifetime occurrence of PEs was assessed, and at each follow-up wave 3-year interval occurrence of PEs.

At each wave, individuals who endorsed at least one PE (scoring a 2 or higher on a psychotic symptom item) were contacted for reinterview over the telephone by an experienced clinician (psychologist or psychiatrist) within 8 weeks after the initial interview. Reinterviews were conducted using questions from the Structured Clinical Interview for DSM-IV (SCID-I), an instrument with proven reliability and validity in diagnosing psychotic disorders (Spitzer & Williams, 1993). As an example, self-reported symptoms that needed to be redefined as hypnopompic of hypnagogic hallucinations, or convictions that did not meet the criteria of a delusional symptom, or appeared due to the use of medications, alcohol, drugs or to physical illness were not considered as PEs. Findings from all reinterviews were discussed with an experienced clinician, who also conducted and supervised the clinical reinterviews in NEMESIS-2. PEs were considered present as 'validated PE' when the psychotic nature of at least one of the self-reported PEs was confirmed at the follow-up interview. Validated PEs were assessed among those who participated in the clinical reinterview; those who could not be reached or refused to take part in the clinical reinterview were defined as missing (Honings et al., 2017).

Incidence and persistence of PE

The at-risk group for any incident PE at a certain period consisted of those who never had any PE before that period. So, the at-risk group for 3-year incidence at T_1 consisted of those who never had any PE at baseline, and the at-risk group for 3-year incidence at T_2 consisted of those who never had any PE at baseline and at T_1.

Persistence was defined as recurrent or continued self-report of PE during follow-up among those with any lifetime PE at baseline (in line with Van Der Steen et al. (2019).

Risk indicators

Most of the below-described risk indicators were previously related to prevalence, incidence, or persistence of PE (see Introduction).

Sociodemographic characteristics were sex, age, education, living situation, job status and urbanicity.

Vulnerability characteristics were: childhood abuse (whether before age 16 one had experienced emotional neglect, psychological abuse or physical abuse on ⩾2 occasions, or sexual abuse on ⩾1 occasion), parental psychopathology (⩾1 biological parent ever having been treated by a psychiatrist, or hospitalized in a mental health institution, or ever having exhibited severe depression, delusions or hallucinations, severe anxiety or phobias, alcohol abuse, drug abuse, regular problems with the police and/or suicidal behaviour) and negative life events (⩾1 of 10 negative life events, such as the death of relative or friend, divorce and financial difficulties, based on Brugha, Bebbington, Tennant, and Hurry (1985).

Physical health and functioning characteristics were: chronic physical disorder (any of 17 chronic physical disorders treated or monitored by a medical doctor in the past 12 months, assessed with a standard checklist), body mass index (BMI; kg/m2), physical active (defined as weekly ⩾1 h of physical exercise/sport in the past 12 months), and physical functioning (combined SF-36 scales general health, physical health, physical functioning, and bodily pain in the past 4 weeks (Ware & Sherbourne, 1992)).

Substance use characteristics were current smoker (in the past month), alcohol use (number of drinks per week in the past 12 months) and cannabis use (in the past 12 months).

Mental health and functioning characteristics were: mood disorder (major depression, dysthymia, bipolar disorder), anxiety disorder (panic disorder, agoraphobia without panic disorder, social phobia, specific phobia, generalized anxiety disorder), alcohol use disorder (abuse and dependence), cannabis use disorder and suicidal thoughts, all assessed with the CIDI 3.0, and mental functioning [combined SF-36 scales psychological health, psychological functioning, social functioning, and vitality in the past 4 weeks (Ware & Sherbourne, 1992)].

Service use indicators were based on self-report and included at least one contact made in mental health care and psychotropic medication use in the past 12 months prescribed by a mental health professional.

Statistical analysis

Analyses were performed using Stata 16.1. First, prevalence, incidence, and persistence rates of PEs at different measurement waves were calculated (Tables 1–3), using weighted data to

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Table 1. Prevalence rates of PEs at all four measurement waves, in numbers and weighted percentages

Self-reported Pes	T_0 $N = 6646$	T_1 $N = 5303$	T_2 $N = 4618$	T_3 $N = 4007$
Lifetime prevalence, *n* (%)	1084 (16.5%)			
3-year prevalence, *n* (%)	–	440 (8.9%)	284 (7.4%)	222 (5.5%)
Validated Pes	T_0 $N = 6358$	T_1 $N = 5232$	T_2 $N = 4564$	T_3 $N = 3954$
Lifetime prevalence, *n* (%)	385 (6.0%)			
3-year prevalence, *n* (%)	–	186 (3.8%)	138 (3.2%)	83 (1.8%)

Note. At T_0–T_2 20 PEs were questioned, at T_3 13 PEs.

Table 2. Incidence rates of PEs at the follow-up measurement waves, in numbers and weighted percentages

Self-reported Pes	T_1 $N = 4450$	T_2 $N = 3711$	T_3 $N = 3140$	T_1–T_2 $N = 3887$	T_1–T_3 $N = 3377$
3-year incidence, *n* (%)	201 (4.8%)	102 (3.4%)	70 (2.0%)		
6-year incidence, *n* (%)	–	–	–	278 (8.2%)	
9-year incidence, *n* (%)	–	–	–	–	307 (9.8%)
Validated Pes	T_1 $N = 4769$	T_2 $N = 4080$	T_3 $N = 3477$	T_1–T_2 $N = 4163$	T_1–T_3 $N = 3600$
3-year incidence, *n* (%)	85 (1.9%)	57 (1.7%)	29 (0.7%)		
6-year incidence, *n* (%)	–	–	–	140 (3.7%)	
9-year incidence, *n* (%)	–	–	–	–	152 (4.6%)

Note. *N* reflects the at-risk group for incident PEs.

Table 3. Persistence rates of PEs at the follow-up measurement waves among those with lifetime PEs at baseline, in numbers and weighted percentages

Self-reported Pes	T_1 $N = 853$	T_2 $N = 731$	T_3 $N = 630$	T_1-T_2 $N = 731$	T_1-T_3 $N = 630$	T_1-T_3 $N = 630$	T_1-T_3 $N = 630$
Any 3-year PE, *n* (%)	239 (30.1%)	146 (22.6%)	109 (17.8%)				
Any 6-year PE, *n* (%)	–	–	–	246 (37.0%)			
Any 9-year PE, *n* (%)	–	–	–	–	244 (41.1%)		
Two consecutive 3-year PE, *n* (%)						96 (17.1%)	
Three consecutive 3-year PE, *n* (%)							46 (7.7%)
Validated Pes	T_1 $N = 307$	T_2 $N = 265$	T_3 $N = 236$	T_1-T_2 $N = 273$	T_1-T_3 $N = 238$	T_1-T_3 $N = 226$	T_1-T_3 $N = 236$
Any 3-year PE, *n* (%)	76 (27.6%)	53 (20.7%)	25 (9.1%)				
Any 6-year PE, *n* (%)	–	–	–	90 (37.3%)			
Any 9-year PE, *n* (%)	–	–	–	–	83 (38.8%)		
Two consecutive 3-year PE, *n* (%)						32 (15.0%)	
Three consecutive 3-year PE, *n* (%)							9 (3.4%)

Note. *N* reflects those with lifetime PEs at baseline and present at follow-up.

correct for differences in the response rates in several sociodemographic groups at all waves and differences in the probability of selection of respondents within households at T_0. Second, logistic regression analyses adjusted for sex and age were performed to examine risk indicators for 3-year prevalence (Table 4), 3-year incidence (Table 5) and 3-year persistence of PEs (Table 6), for both self-reported and validated outcomes. For these analyses data from multiple measurement waves were coded into long format (i.e. each row is one time point per respondent). So, each respondent will have data in multiple rows. The cluster option is used to correct for multiple observations within subjects (in line with Guloksuz et al. (2018)). As these analyses focus on association rather than on calculating rates, sampling weights were not applied [as in Honings et al.

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Table 4. Risk-indicators of 3-year prevalence rates of PEs[a], in odds ratios adjusted for sex and age (continuous variable in years) (aOR) and 95% confidence intervals

	Self-reported PE ($n = 946$) $N = 13\,928$ aOR (95% CI)	Validated PE ($n = 407$) $N = 13\,750$ aOR (95% CI)
Sociodemographic characteristics		
Female gender	1.50 (1.26–1.78)***	1.67 (1.30–2.15)***
Age at interview (Ref: 18–34 years)		
35–44	0.79 (0.62–1.01)	0.82 (0.58–1.17)
45–54	0.69 (0.55–0.89) **	0.66 (0.46–0.94) *
55–64	0.74 (0.58–0.95) *	0.90 (0.63–1.28)
65–85	0.45 (0.34–0.60) ***	0.52 (0.34–0.79) **
Education (Ref: higher professional, university)		
Primary, basic vocational	2.48 (1.68–3.68)***	2.80 (1.62–4.85)***
Lower secondary	1.98 (1.58–2.48)***	1.73 (1.24–2.42)**
Higher secondary	1.75 (1.42–2.16)***	1.93 (1.42–2.63)***
Living without partner	2.17 (1.84–2.56)***	2.16 (1.70–2.73)***
No paid job	2.03 (1.68–2.45)***	2.51 (1.91–3.31)***
Vulnerability characteristics		
Any childhood abuse	2.41 (2.03–2.85)***	2.97 (2.33–3.80)***
Any 3-year negative life events	2.41 (1.97–2.96)***	2.46 (1.80–3.37)***
Parental psychopathology[b]	2.10 (1.73–2.56)***	2.02 (1.51–2.71)***
Physical health and functioning		
Any chronic physical disorder	1.60 (1.37–1.87)***	1.67 (1.33–2.09)***
Body mass index	1.03 (1.01,1.05)**	1.04 (1.01–1.07)**
Number of physical active hours per week	0.95 (0.91,0.99)*	0.91 (0.85–0.98)**
Physical functioning scale[c]	0.97 (0.97–0.98)***	0.97 (0.97–0.98)***
Substance use		
Current smoker	1.98 (1.66–2.35)***	2.22 (1.74–2.84)***
Number of alcoholic drinks per week	1.01 (0.99–1.02)	1.01 (0.99–1.02)
Any cannabis use	2.14 (1.52–3.01)***	2.60 (1.66–4.07)***
Mental health and functioning		
Any 3-year mood disorder	3.68 (3.03–4.47)***	4.21 (3.22–5.51)***
Any 3-year anxiety disorder	3.68 (3.01–4.48)***	4.28 (3.29–5.58)***
Any 3-year alcohol abuse	1.48 (0.99–2.23)	1.78 (1.03–3.07)*
Any 3-year alcohol dependence	4.23 (2.55–7.03)***	4.38 (2.22–8.67)***
Any 3-year cannabis abuse	2.09 (0.59–7.41)	3.66 (0.82–16.31)
Any 3-year cannabis dependence	7.77 (3.31–18.21) ***	7.40 (2.46–22.25)***
Any 3-year suicidal thoughts	7.36 (5.54–9.77)***	7.93 (5.55–11.33)***
Mental functioning scale[b]	0.97 (0.96–0.97)***	0.96 (0.96–0.97)***
Service use		
Any psychotropic medication use[d]	3.55 (2.83–4.44)***	4.24 (3.17–5.66)***
Mental health care use in past 3 year	3.00 (2.50–3.61)***	3.07 (2.35–4.03)***

The total number of PEs in this Table corresponds to the sum of the numbers right of the vertical line in Table 1.
[a]Reference group: those without a corresponding self-report or validated 3-year prevalence of PEs.
[b]These analyses were based on data from the second wave only, because parental psychopathology was only assessed at that wave. The N was 5303 and 5232 in the analyses for self-reported PEs and validated PEs, respectively.
[c]This scale ranges from 0 (low functioning/ill health) up until 100 (high functioning/good health).
[d]This included antidepressants, antipsychotics, benzodiazepines, mood stabilizers, other anxiolytics, and sedatives.
*: $p < 0.05$; **: $p < 0.01$; ***: $p < 0.001$.

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Table 5. Risk-indicators of 3-year incidence rates of PEs[a], in odds ratios adjusted for sex and age (continuous variable in years) (aOR) and 95% confidence intervals

	Self-reported PE ($n = 373$) $N = 11\,301$ aOR (95% CI)	Validated PE ($n = 171$) $N = 12\,326$ aOR (95% CI)
Sociodemographic characteristics		
Female gender	1.33 (1.08–1.65)**	1.28 (0.94–1.75)
Age at interview (Ref: 18–34 years)		
35–44E	0.81(0.60–1.10)	0.76 (0.48–1.20)
45–54	0.75 0.55–1.02)	0.79 (0.51–1.23)
55–64	0.67 (0.49–0.92) *	0.77 (0.49–1.19)
65–85	0.62 (0.40–0.99) *	0.44 (0.20–0.95) *
Education (Ref: higher professional, university)		
Primary, basic vocational	2.44 (1.52–3.95)***	3.78 (2.02–7.06)***
Lower secondary	1.83 (1.39–2.41)***	1.94 (1.28–2.94)**
Higher secondary	1.36 (1.05–1.77)*	1.77 (1.19–2.62)**
Living without partner	1.81 (1.46–2.24)***	1.75 (1.28–2.39)***
No paid job	1.75 (1.37–2.23)***	2.03 (1.42–2.90)***
Vulnerability characteristics		
Any childhood abuse	1.65 (1.32–2.05)***	2.17 (1.60–2.95)***
Any 12-month negative life events	1.61 (1.30–1.99)***	1.62 (1.19–2.21)**
Parental psychopathology[b]	1.71 (1.14–2.55)**	1.78 (1.05–3.00)*
Physical health and functioning		
Any chronic physical disorder	1.22 (0.98–1.53)	1.68 (1.22–2.31)**
Body mass index	1.01 (0.99–1.04)	1.02 (0.98–1.06)
Number of physical active hours per week	0.96 (0.91–1.02)	0.90 (0.81–1.00)
Physical functioning scale[c]	0.98 (0.98–0.98)***	0.97 (0.97–0.98)***
Substance use		
Current smoker	1.41 (1.13–1.78)**	1.49 (1.07–2.06)*
Number of alcoholic drinks per week	1.00 (0.98–1.02)	1.00 (0.97–1.02)
Any cannabis use	1.44 (0.87–2.38)	1.57 (0.76–3.25)
Mental health and functioning		
Any 12-month mood disorder	2.09 (1.42–3.07)***	2.09 (1.22–3.58)**
Any 12-month anxiety disorder	2.31 (1.68–3.18)***	3.01 (2.00–4.53)***
Any 12-month alcohol abuse	1.56 (0.86–2.83)	1.43 (0.58–3.51)
Any 12-month alcohol dependence	1.39 (0.33–5.91)	1.40 (0.19–10.19)
Any 12-month cannabis abuse	11.26 (3.42–37.06) ***	9.42 (2.06–43.01)**
Any 12-month cannabis dependence	2.23 (0.29–17.18)	4.12 (0.54–31.35)
Any 12-month suicidal thoughts	3.53 (1.67–7.46)***	3.06 (1.13–8.34)*
Mental functioning scale[b]	0.98 (0.97–0.98)***	0.98 (0.97–0.98)***
Service use		
Any psychotropic medication use[d]	2.39 (1.68–3.40)***	2.88 (1.81–4.58)***
Mental health care use in past 12-months	1.82 (1.28–2.60)***	1.73 (1.04–2.88)*

The total number of PEs in this Table corresponds to the sum of the numbers left of the vertical line in Table 2.
[a]Reference group: those without a corresponding self-report or validated 3-year incidence of PEs.
[b]These analyses were based on data from the second wave only, because parental psychopathology was only assessed at that wave. The N was 3711 and 4080 in the analyses for self-reported PEs and validated PEs, respectively.
[c]This scale ranges from 0 (low functioning/ill health) up until 100 (high functioning/good health).
[d]This included antidepressants, antipsychotics, benzodiazepines, mood stabilizers, other anxiolytics, and sedatives.
*: $p < 0.05$; **: $p < 0.01$; ***: $p < 0.001$.

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Table 6. Risk-indicators of 3-year persistence rates of PEs[a] among those with lifetime PEs at baseline, in odds ratios adjusted for sex and age (continuous variable in years) (aOR) and 95% confidence intervals

	Self-reported PE ($n = 494$) $N = 2214$ aOR (95% CI)	Validated PE ($n = 154$) $N = 808$ aOR (95% CI)
Sociodemographic characteristics		
Female gender	1.36 (1.03–1.79)*	1.49 (0.92–2.43)
Age at interview (Ref: 18 t/m 34 years)		
35-44	0.91 (0.64–1.30)	1.00 (0.55–1.84)
45-54	0.82 (0.58–1.14)	0.89 (0.48–1.66)
55-64	0.73 (0.51–1.04)	0.93 (0.50–1.71)
65-85	0.39 (0.22–0.28) **	0.51 (0.18–1.42)
Education (Ref: higher professional, university)		
Primary, basic vocational	1.51 (0.81–2.84)	2.07 (0.67–6.39)
Lower secondary	1.49 (1.04–2.13)*	1.23 (0.64–2.38)
Higher secondary	1.85 (1.31–2.61)***	2.00 (1.13–3.54)*
Living without partner	1.68 (1.30–2.18)***	1.71 (1.09–2.68)*
No paid job	1.64 (1.25–2.15)***	1.87 (1.19–2.94)**
Vulnerability characteristics		
Any childhood abuse	1.71 (1.31–2.22)***	2.23 (1.37–3.63)**
Any 12-month negative life events	1.41 (1.14–1.73)**	1.30 (0.89–1.89)
Parental psychopathology[b]	2.04 (1.41–2.96)***	1.53 (0.82–2.84)
Physical health and functioning		
Any chronic physical disorder	1.65 (1.31–2.07)***	1.99 (1.32–2.99)**
Body mass index	1.01 (0.98–1.04)	1.04 (0.98–1.10)
Current smoker	1.37 (1.05–1.78)*	2.02 (1.27–3.24)**
Number of alcoholic drinks per week	1.00 (0.99–1.02)	1.00 (0.97–1.03)
Any cannabis use	1.20 (0.70–2.04)	1.25 (0.55–2.81)
Number of physical active hours per week	0.97 (0.91–1.02)	0.97 (0.90–1.04)
Physical functioning scale[c]	0.98 (0.97–0.98)***	0.98 (0.97–0.99)***
Substance use		
Current smoker	1.37 (1.05–1.78)*	2.02 (1.27–3.24)**
Number of alcoholic drinks per week	1.00 (0.99–1.02)	1.00 (0.97–1.03)
Any cannabis use	1.20 (0.70–2.04)	1.25 (0.55–2.81)
Mental health and functioning		
Any 12-month mood disorder	2.21 (1.59–3.08)***	2.28 (1.37–3.82)**
Any 12-month anxiety disorder	2.24 (1.68–3.00)***	1.91 (1.18–3.07)**
Any 12-month alcohol abuse	1.24 (0.66–2.35)	0.77 (0.17–3.54)
Any 12-month alcohol dependence	3.55 (1.48–8.54)**	1.18 (0.27–5.18)
Any 12-month cannabis abuse	1.89 (0.43–8.31)	1.00 (1.00–1.00)
Any 12-month cannabis dependence	3.02 (1.08–8.47)	2.34 (0.25–21.68)
Any 12-month suicidal thoughts	3.67 (2.13–6.31)***	3.45 (1.55–7.68)**
Mental functioning scale[b]	0.98 (0.97–0.98)***	0.98 (0.97–0.99)***
Service use		
Any psychotropic medication use[d]	2.31 (1.66–3.23)***	2.53 (1.51–4.22)***
Mental health care use in past 12-months	2.11 (1.53–2.90)***	2.24 (1.35–3.72)**

The total number of PEs in this Table corresponds to the sum of the numbers left of the vertical line in Table 3.
[a]Reference group: those without a corresponding self-report or validated 3-year persistence of PEs.
[b]These analyses were based on data from the second wave only, because parental psychopathology was only assessed at that wave. The N was 731 and 265 in the analyses for self-reported PEs and validated PEs, respectively.
[c]This scale ranges from 0 (low functioning/ill health) up until 100 (high functioning/good health).
[d]This included antidepressants, antipsychotics, benzodiazepines, mood stabilizers, other anxiolytics, and sedatives.
*: $p < 0.05$; **: $p < 0.01$; ***: $p < 0.001$.

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(2016)]. For Table 4, the risk indicators and outcome variables were assessed at the same wave (i.e. T_1, T_2 or T_3). For Tables 5 and 6, the risk indicators were assessed in the wave prior to the outcome variables.

Results

Prevalence

Based on self-report, at baseline 1084 respondents (16.5%) had at least one PE in their lifetime (Table 1). The validated lifetime prevalence was 6.0%. During the 3-year after baseline, 8.9% of the respondents had experienced one or more PEs according to self-report and 3.8% according to validated PE. 3-year prevalence rates were somewhat lower at T_2 (7.4% for self-reported and 3,2% for validated PEs) and further decreased at T_3 (5,5% for self-reported and 1,8% for validated PEs). Among those with a 3-year prevalence of self-reported and validated PE, 41.1% and 41.3% respectively reported at least two PEs.

Incidence

Among those who never had any lifetime PE at baseline (n = 4450), 201 respondents (4.8%) reported at least one PE during the first 3-year follow-up period (T_1). The 3-year incidence rate of validated PE at T_1 was 1.9%.

For both self-reported and validated PEs, the 3-year incidence rates at the second and third follow-up period (T_2 and T_3) were somewhat lower compared to those at T_1. Not surprisingly, higher 6- and 9-year incidence rates were found: among those who never had any lifetime PE at baseline, 8.2% of respondents reported at least one PE during 6-year follow up and 9.8% during 9-year follow-up. For the validated PEs, these percentages were respectively 3.7% and 4.6%.

Persistence

Among those with at least one lifetime PE at baseline, 30.1% also self-reported a PE at 3-year follow-up. Among those with lifetime PE at baseline, almost one in four (22.6%) had a PE in the second 3-year follow-up period and 17.8% in the third 3-year follow-up period. A limited number of baseline endorsers (7.7%) self-reported at least one PE in all three follow-up periods.

Differences in persistence rates between self-reported and validated PEs were small except at the third follow-up period (persistence rate was 17.8% based on self-reported and 9.1% on validated PEs) and the three-year consecutive PE (7.7% based on self-reported and 3.4% on validated PEs).

Risk indicators of prevalence, incidence, and persistence

As shown in Table 4, all putative risk indicators were associated with both self-reported and clinically validated 3-year prevalence of PE, except for living in an urban area, number of alcoholic drinks per week and any 3-year cannabis abuse. 3-year alcohol abuse was not associated with self-reported PE. The highest ORs were found for any 3-year suicidal thoughts and any 3-year cannabis dependence. The strength of the associations (in terms of point estimate of each risk indicator) for both types of PE was similar.

A great number of risk indicators were associated with both self-reported and clinically validated 3-years incidence of PE (Table 5). The highest OR was found for any 12-month cannabis abuse. Point estimates for validated and self-reported PE showed little differences. Compared to the risk indicators for the presence of PE (Table 4), fewer physical health and physical functioning risk indicators were associated with the incidence of PE.

Table 6 shows that 18 out of 26 risk indicators were associated with self-reported, and 13 out of 26 risk indicators with clinically validated 3-year persistence of PE. The highest OR was found for any 12-month suicidal thoughts. The strength of most of the associations was similar for validated PE and self-reported PE. Compared to the risk indicators for the presence of PE (Table 4), fewer physical health and physical functioning risk indicators were associated with the persistence of PE. Comparison with the risk indicators of the incidence of PE (Table 5) showed few notable differences.

Discussion

Key findings

To our knowledge, the present study is the first to analyse, in one population-based dataset, the prevalence, incidence and persistence of, and risk indicators for PEs. Moreover, results are reported for both self-reported and validated PE. This representative cohort study among the general Dutch adult population, showed that, at baseline, 16.5% had at least one self-reported PE in their lifetime. The incidence of self-reported PE at first 3-year follow-up, among those who never had any lifetime PE, was 4.8%. Among those who had at least one lifetime PE at baseline, 30.1% also self-reported a PE at 3-year follow-up. Compared to validated PE, self-report estimates of PE prevalence and incidence were two to three times higher, while differences for PE persistence were generally small. The 3-year prevalence of PE was associated with all sociodemographic, vulnerability, mental health and physical health and functioning, and service use indicators, except for urbanicity, alcohol use, cannabis abuse and alcohol abuse (self-reported). Generally, the strongest associations were found for mental health disorders. Compared to the risk indicators for the presence of PE, fewer physical health risk indicators were associated with the incidence of PE. The risk-indicator set for the persistence of PE showed few differences with that for the incidence of PE. The strength of the risk indicators for presence, incidence and persistence of PE did not differ much for self-reported and validated PE.

Discussion of research findings

The self-reported lifetime prevalence in our study (16.5%) is almost three times higher than the validated lifetime prevalence of PEs (6.0%). This corresponds to Linscott and Van Os (2013) who concluded that studies based on self-report generated rates more than three times greater than rates obtained by interview-based assessments. Although these excess cases based on self-report could be labelled as 'false positives', studies have shown that compared with those without PEs, 'false positives' display stronger associations with several negative outcomes, e.g., psychotic as well as several non-psychotic disorders, although at a lower level than the validated cases (Bak et al., 2003; Van Nierop et al., 2012). This implies that PEs not confirmed by clinical interview may represent the softest expression of an extended psychosis phenotype that is phenotypically continuous with clinical psychosis (Van Nierop et al., 2012). The validated lifetime prevalence of PEs in our study (6.0%) is comparable to a

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meta-analytical estimate of 7.2% (Linscott & Van Os, 2013). The self-reported lifetime prevalence in the present study (16.5%) is higher than that in the WMH Surveys [5.8%; (McGrath et al., 2015)]. This may be due to differences in the assessment, i.e., in the present study respondents were asked to indicate the occurrence of 20 types of PE compared to 6 PE types in the WMH Surveys.

The 3-year self-reported incidence rate in our study was 4.8% and the validated 1.9%, which seems low compared to the median annual incidence of 2.5% as reported by Linscott and Van Os (2013). The self-reported PE persistence rate (30.1%) was comparable to the retrospective estimate of the WMH Surveys (28.1%), although the length of the persistence interval differed (3 *v.* 1 year). Two other studies reported lower persistence estimates than the present study, i.e., 21,1% (based on four cohorts, with intervals varying from 1 to 8 years [Linscott & Van Os, 2013)] and 15.1% [2-year interval; Chan et al. (2020)]. Besides differences between studies in the length of persistence intervals, other methodological differences may account for the heterogeneity in persistence rates across studies. For example, in our study PE persistence was conditional on the lifetime prevalence of PE at baseline, while in Chan et al. (2020) PE persistence was conditional on a 12-month prevalence of PE at baseline.

In line with previous cross-sectional studies, this study found that demographic factors (female sex, younger age, not being highly educated, living without a partner, having no paid job), vulnerability characteristics (any childhood abuse, negative life events, parental psychopathology), substance use (smoking, cannabis use), poor mental health (mood and anxiety disorder, suicidal thoughts and alcohol and cannabis dependence) and service use (any psychotropic medication use and mental health care use in the past 12-months) were associated with the 3-year prevalence of PE (Bourgin et al., 2020; Bromet et al., 2017; Mallet et al., 2018; McGrath et al., 2015, 2016, 2017a, 2017b; Oh et al., 2020; Ragazzi et al., 2018; Saha, Scott, Varghese, & McGrath, 2012; Stickley et al., 2019). In addition, we found associations between PE prevalence and physical health and functioning factors, which have been scarcely studied. An Australian study found an association between PE and physical disorders (Saha, Scott, Varghese, & McGrath, 2011b) and a study in the US found associations with several health conditions, including chronic pain, and sleep disorder (Oh, Waldman, Stickley, DeVylder, & Koyanagi, 2019). In the present study, no association was found between PE and urbanicity. The literature shows mixed results (Quattrone et al., 2019; Scott et al., 2006; Van Os et al., 2001; Wiles et al., 2006). A review on the relationship between urbanicity and psychotic disorder concluded that results are heterogenous and that multiple risk and protective factors act differently in different ethnic groups and countries (Fett, Lemmers-Jansen, & Krabbendam, 2019). This complexity may also be applicable to the urbanicity-PE relationship and thereby explain the mixed findings in the literature.

Sociodemographic risk indicators associated with the prevalence were also associated with the incidence of PE, except for female sex and age at the interview for validated PE. Other studies suggest there is no association between female sex and PE incidence (Kirli et al., 2019b; Linscott & Van Os, 2013; Wiles et al., 2006). The literature is mixed with respect to age, possibly due to differences in the operationalization of the age variable, i.e., continues (Linscott & Van Os, 2013) or categorical (Kirli et al., 2019b). All vulnerability characteristics were associated with PE incidence, which is in line with other studies finding an association between negative life events and PE incidence (Kırlı et al., 2019a; Spauwen et al., 2006; Wiles et al., 2006), family history of mental disorder and childhood adversity (Bennett et al., 2020; Kırlı et al., 2019a).

While all physical health and functioning characteristics were associated with the prevalence of PE, associations with PE incidence are only found for physical functioning and any chronic physical disorder (validated PE only). We found one study on this topic, which reported associations between frequent or severe headache, other chronic pain, asthma and subsequent PEs (Scott et al., 2018). The results of this cross-sectional study were however based on retrospectively assessed PEs and medical conditions using their age of onset (Scott et al., 2018).

Current smoking, but not number of alcoholic drinks and any cannabis use, was associated with the incidence of PE. This is in line with Wiles et al. (2006), who found that smokers had a 70% greater risk of PE incidence and found no association between any cannabis use and PE incidence. With respect to alcohol, studies using other alcohol outcome measures than the present study, i.e., weekly alcohol use (Kırlı et al., 2019a) and engaging in a harmful pattern of drinking (Wiles et al., 2006), did find an association with incident PE. This is also the case for cannabis use, i.e., associations with incident PE were found for regular cannabis use (Kırlı et al., 2019a), (degree of) misuse (Linscott & Van Os, 2013) and cannabis abuse in the present study. These findings suggest that particularly frequent or problematic alcohol and cannabis use is associated with incident PE.

Any 12-month mood, and anxiety disorder, suicidal thoughts, lower mental functioning, any psychotropic medication use, and any 12-month mental health care use were all risk indicators for the 3-year incidence of PEs. One of the few longitudinal studies on this topic also found that mood episodes and psychotropic medication use predicted incident PEs (Kırlı et al., 2019a).

Risk indicators for persistence were largely similar to those for incidence of PE, although some variables did not reach statistical significance, most likely due to a much smaller sample size of the group at risk for persistence. As noted earlier, very few studies have reported on risk indicators of the persistence of PE. The association with vulnerability characteristics is also reported by others (Cougnard et al., 2007; Rössler et al., 2007; Trotta et al., 2015). Unlike Cougnard et al. (2007) we found no association between PE persistence and living in an urban area. Furthermore, we found PE persistence to be associated with mental health indicators, including mood and anxiety disorders, while another study did not (DeVylder et al., 2015). However, the latter result was based on retrospectively assessed information.

Limitations

The following study limitations should be mentioned. First, the incidence estimates are based on self-reported lifetime disorders at baseline and 3-year disorders at follow-up. Especially the validity of lifetime diagnoses has been questioned on grounds of difficulty of accurate recall, resulting in underreporting of lifetime symptoms at baseline (Moffitt et al., 2010; Patten, 2009; Wittchen, 1989). The presented incidence rates might therefore be somewhat overestimated and persistence rates underestimated (Chou, Mackenzie, Liang, & Sareen, 2011). We do not expect that this has had any meaningful effect on the magnitude of the associations between PE's and risk indicators.

Second, in prospective studies, the validity of the follow-up data can be adversely affected by sample attrition (de Graaf

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et al., 2010; Eaton, Romanoski, Anthony, & Nestadt, 1991; Lamers et al., 2012). However, no such bias was found for PE and the disorders under investigation here, after controlling for demographics (Nuyen et al., 2021). We therefore assume that sample attrition had little effect on the incidence and persistence rates and risk associations reported here, also because the data were weighted for attrition due to sociodemographic characteristics.

Third, although the sample was representative of the Dutch population on most parameters, people with an insufficient mastery of Dutch, those with no permanent residential address and the institutionalized were underrepresented. Hence, our findings cannot be generalized to these groups, such as the most severely affected psychotic patients.

Fourth, our analyses on risk indicators were explorative in nature. We looked at a wide variety of possible risk indicators from different domains based on previous research. Future research is needed to gain insight into how risk indicators are related to variations in the disease course and which mechanisms play a part, i.e. by studying whether factors play a mediating or moderating role.

Conclusions

The results of our study show that a wide variety of risk indicators is associated with PE prevalence and, to a somewhat lesser extent, with PE incidence and persistence. The associations with mental health disorders were relatively strong, which underlines the importance of assessment of PE in general practice. Comparison of self-reported and clinically validated results showed few differences with respect to risk indicators. Prevalence and incidence were higher in self-report than validated results. However, previous studies have shown that self-reported cases that are not confirmed in clinical interview, are also at higher risk for psychotic as well as several non-psychotic disorders. Thus, also self-report of PE is a valuable tool in clinical practice.

Supplementary material. The supplementary material for this article can be found at https://doi.org/10.1017/S0033291722002690.

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Conflicts of interest. None.

Ethical standards. The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

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