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Psychotic-like experiences of young adults in the general population predict mental disorders

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ABSTRACT

Psychotic-like experiences (PLEs) have been identified as risk markers for psychotic disorders and may indicate an individual's susceptibility to mental disorders in general. We examined whether 23 PLEs (assessed with M-CIDI questionnaire) reported in young adulthood (n = 1313) predict subsequent psychotic or any mental disorders in the general population. We also investigated whether these possible associations are explained by general psychological distress assessed with the General Health Questionnaire-12 (GHQ-12). The register follow-up period spanned 10–12 years. In Cox regression models, PLEs predicted subsequent psychotic disorders (n = 12) when the effects of age, sex, education, and marital status were adjusted for, but not when general psychological distress was added to the model. Having any mental disorders during follow-up (n = 91) was predicted by PLEs reported at a younger age, when controlling for age, sex, education, marital status, and general psychological distress. In line with earlier results in other age groups, PLEs can be seen as a sign of vulnerability to not just psychotic but all mental disorders during the following years also among young adults in the general population. PLEs were a predictive marker of general psychopathology independently from general psychological distress.

1. Introduction

Psychotic-like experiences (PLEs) are perceptions, thoughts, or beliefs that are considered odd, unusual, or unreal, and are commonly experienced also in the general population (Linscott and van Os, 2013; McGrath et al., 2015). PLEs are especially common among younger people, and are more frequent among females, non-married individuals, and people with low socioeconomic status (Bourgin et al., 2020; Linscott and van Os, 2013; Pignon et al., 2018; Scott et al., 2006).

Originally, the detection and predictive value of psychosis risk status have been of interest especially among clinical, help-seeking populations (Fusar-Poli et al., 2020). However, lately interest has shifted also to the general population (Veijola et al., 2013), where PLEs predict later psychotic disorders as well (Hanssen et al., 2005; Kaymaz et al., 2012; Linscott and van Os, 2013), although sometimes with modest sensitivity (Sullivan et al., 2020).

In addition to being a psychosis risk marker, PLEs have been suggested as a sign of broader psychological vulnerability and a transdiagnostic clinical marker of clinically significant mental health problems (Kelleher and Cannon, 2021, 2016). Cross-sectionally, PLEs are associated with the presence of psychiatric disorders in general (Bhavsar et al., 2021; Bourgin et al., 2020; Degenhardt and Hall, 2001; Johns et al., 2004; Koyanagi et al., 2016; Pignon et al., 2018; Varghese et al., 2011; Wigman et al., 2012). Longitudinally, PLEs have been found to predict subsequent mental disorders in young adults (McGrath et al., 2016; Rössler et al., 2011). Early detection of risk factors to mental health problems would enable preventive service improvement, and PLEs could be a useful indicator of later mental health needs at a population level (Bhavsar et al., 2021; Healy and Cannon, 2020).

PLEs reported in different ages may carry different meanings in terms of mental disorder risk. Studies have found PLEs predicting mental disorders especially in adolescence (Carey et al., 2020; Fisher et al., 2013; Kelleher et al., 2012; Poulton et al., 2000; Trotta et al., 2020) and the meaning of PLEs in adulthood has been studied less. In young adults, PLEs predicted later psychotic disorders as well as other severe mental disorders (Werbeloff et al., 2012), whereas PLEs of middle-aged adults

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Table 1
The items assessing PLEs, with endorsement proportions and factor loadings, and HR predicting psychosis ($n = 1313$).

Experience	Endorsement% (whole sample)	Standardized factor loading	Standardized threshold	HR for psychosis	95% CI
1. Have you ever believed people were spying on you?	5.8	0.79	1.57	**5.17**	**1.40–19.16**
2. Was there ever a time when you believed people were following you?	**14.1**	0.78	1.08	1.99	0.58–6.86
3. Have you been convinced that people you saw talking to each other were talking about you or laughing at you?	**38.8**	0.64	0.29	1.36	0.40–4.59
4. Have you ever believed that you were being secretly tested or experimented on?	0.6	**0.93**	2.51	0.00	N/A
5. Have you ever believed that someone was plotting against you or trying to hurt you or poison you?	5.3	0.77	1.62	**4.27**	**1.44–20.47**
6. Have you ever been convinced that someone you had not met was in love with you?	4.6	0.53	1.69	0.00	N/A
7. Have you ever been unreasonably convinced that your spouse or partner was being unfaithful, although they told you that was not true?	**15.1**	0.53	1.03	1.67	0.47–5.97
8. Have you ever believed that someone was reading your mind?	9.5	0.82	1.31	**4.52**	**1.32–15.49**
9. Have you ever been convinced you could actually hear what another person was thinking, even though he or she was not speaking?	2.9	0.86	1.90	3.15	0.61–16.36
10. Have you ever been convinced that others could hear your thoughts?	2.4	0.84	1.98	1.85	0.22–15.90
11. Have you ever been convinced that you were under the control of some power or force, so that your actions and thoughts were not your own?	2.4	0.81	1.97	4.95	0.99–24.71
12. Have you ever been convinced that strange thoughts, or thoughts that were not your own, were being put directly into your mind?	1.1	0.84	2.30	8.31	0.95–72.82
13. Have you ever been convinced that someone or something could take or steal your thoughts out of your mind?	0.8	**0.87**	2.39	7.58	0.95–60.59
14. Have you ever been convinced that you were being sent special messages through television or the radio, or that a program had been arranged just for you alone?	0.8	**0.96**	2.43	6.33	0.76–52.97
15. Have you felt that a book, or newspaper, or song was meant only for you and no one else?	2.8	0.72	1.92	**8.92**	**2.17–36.61**
16. Have you ever felt strange forces working on you, as if you were being hypnotised or magic was being performed on you, or you were being hit by x-rays or laser beams?	2.6	0.83	1.94	**8.89**	**2.36–33.60**
17. Have you ever seen something or someone that others who were present could not see – that is, had a vision or hallucination when you were completely awake?	4.0	0.73	1.75	**5.21**	**1.35–20.19**
18. Have you more than once heard things other people couldn't hear, for example sounds or something like a voice?	5.1	0.74	1.64	**4.27**	**1.13–16.13**
19. Have you ever been bothered by strange smells around you that nobody else seemed to be able to smell, perhaps even unusual odours coming from your own body?	5.2	0.62	1.62	2.55	0.55–11.86
20. Have you ever had strange tastes in your mouth that could not be explained by anything you had eaten or put in your mouth?	1.7	0.78	2.12	**10.78**	**2.13–54.59**
21. Have you ever had unusual feelings on your skin or inside your body - like being touched when nothing was there or feeling something moving inside your body?	4.1	0.75	1.73	2.73	0.57–13.03
22. Have you ever had a time when you were unable to move at all when it wasn't due to a physical or other medical reason?	2.3	0.75	2.00	**12.74**	**3.44–47.20**
23. Have you ever had a time when you moved constantly and couldn't stop when it wasn't due to a physical or other medical reason?	3.4	0.75	1.83	**6.41**	**1.62–25.40**

Note: The three most commonly endorsed experiences and the three with the strongest factor loadings are in boldface.
HR, Hazard ratio for psychosis controlling for age, sex, education, marital status, and GHQ-12 score. Significant values ($p < .05$) are in boldface.

were not predictive of psychosis (Wikström et al., 2018). However, in a recent large general population study, hallucinatory experiences were associated with increased risk for mental disorders in all adult age groups, suggesting psychopathologic significance across the lifespan (Yates et al., 2021).

This study aims to further elucidate the significance of PLEs in general population young adults. We investigated whether PLE intensity reported at age 19–35 predicted subsequent psychotic / any mental disorders during the next 10–12 years, with the hypothesis that it would predict both. Age, sex, education, and marital status are known to associate with PLEs, and we investigated the additive predictive value of PLEs when these background factors are accounted for.

The mechanisms through which PLEs indicate mental health risks are not fully known. Rather than a risk factor *causing* mental illnesses, PLEs are thought to be a marker signaling accumulated risk factors of the person (Trotta et al., 2020). Therefore, the possible association between PLEs and mental disorders could be explained by unspecific psychological distress, as a parallel general marker to PLEs. As an additional question, we thus wanted to explore whether the value of PLEs in predicting diagnosis outcomes would be beyond that of general psychological distress, as measured with the General Health Questionnaire-12 (Goldberg et al., 1997), commonly used for general mental health screening. The GHQ score has been found to associate with PLEs in adolescents and young adults (Armando et al., 2012, 2010; Hafeez and Yung, 2020; Vellante et al., 2012) and some studies have evaluated GHQ-12 as a psychosis risk screening aid, albeit with low sensitivity (Razali et al., 2015). If the predictive value of PLEs is independent of general psychological distress, this would suggest a specific significance of psychosis spectrum experiences as risk symptoms independent of general mental health distress.

2. Methods

2.1. Participants

The Health 2000 study conducted in 2000–2001 was a nationally representative survey of the Finnish population using stratified two-staged cluster sampling (Aromaa and Koskinen, 2004). The Mental Health in Early Adulthood in Finland (MEAF) study was a follow-up study of the Health 2000 young adult sample. In 2003–2005, a questionnaire focusing on mental health was sent to a nationally representative two-stage cluster sample, consisting of 1863 young adults from 19 to 35 years, and the questionnaire was returned by 1316 respondents (Suvisaari et al., 2009). The questionnaire was used as a screen to further evaluations, but here, only the questionnaire information is used alongside the register follow-up. After excluding three people with no answers to the PLE items, the final sample was 1313 young adults from the general population.

All participants gave written informed consent, and the study was approved by the ethics committees of the Hospital District of Helsinki and Uusimaa and the Finnish Institute for Health and Welfare. The study was carried out in accordance with the sixth version of the Declaration of Helsinki (World Medical Association, 2000).

2.2. Baseline questionnaires

The participants' lifetime PLEs were evaluated with the Finnish translation of G-section questionnaire of the Composite International Diagnostic Interview, Munich version (M-CIDI) (Wittchen et al., 1998). A list of 23 PLEs (Table 1) is presented, asking if the respondents have ever experienced them, the response options being yes or no. Five of the experiences are hallucinatory and 16 delusional, with two symptoms probing catatonic-like symptoms. Good retest reliability has been reported concerning this measure (Wittchen et al., 1998).

The PLE items in the CIDI questionnaire may vary in terms of endorsement and severity, and do not necessarily represent the latent PLE dimension equally. Therefore, instead of using a sum score of the experiences, which would function especially poorly when items have low endorsement rates, a latent factor of the PLEs was formed, as described below in the Analyses section. We also looked at the individual PLEs, as it is valuable to find out which experiences are the most predictive.

General psychological distress was assessed with the GHQ-12 (Goldberg et al., 1997). With 12 items and a four-point verbal response scale (coded 1–4), it assesses current, nonspecific distress, with higher score indicating higher distress. Earlier papers have reported good reliability and validity of the GHQ-12 measure, which serves as a good indicator for current mental health problems (Anjara et al., 2020; Elovainio et al., 2020; Hankins, 2008; Holi et al., 2003). The GHQ-12 sum was used here as a continuous variable (score range 12–48), reflecting general mental health burden.

2.3. Register follow-up

Diagnoses of psychiatric disorders given in specialized psychiatric outpatient care and any inpatient care were obtained from the Care Register for Health Care from the beginning of 1996 until the end of 2015; the follow-up period was thus 10–12 years, the median being 11.4 years. Participants who had died before the end of 2015 were censored at their day of death. Those with previous diagnoses were left out of the analyses. The outcomes of interest were 1) psychotic disorder, ICD-10 diagnosis F20–F29, and 2) any mental disorder F00–F99, including psychotic disorders. The outcome was coded 1 if the person had received the diagnosis in question for the first time during the follow-up after the baseline questionnaire, and otherwise coded as 0.

2.4. Analyses

A one-factor solution of the categorical PLE responses representing a latent trait was estimated in Mplus 8.3 (Muthén and Muthén, 2017) using the robust WLSMW estimator. Standardized *Maximum a posteriori* factor scores were calculated for further analyses. All other analyses were done with IBM SPSS Statistics for Windows, version 27 (IBM Corp., 2020) using $p < .05$ as a limit for statistical significance.

Table 2
Demographic information of the participants at baseline: total sample and the subsamples with the studied outcomes. Frequency (percent) or mean (SD), range.

	Total, n = 1313	Psychosis outcome, n = 12	Any mental disorder outcome, n = 91
Sex:			
Female	711 (54.2%)	8 (66.7%)	67 (73.6%)
Male	602 (45.8%)	4 (33.3%)	24 (26.4%)
Age	27.9 (3.6), 19.4–34.8	27.7 (3.5), 22.1–33.5	28.0 (3.7), 21.3–34.4
Basic education:			
less than high school	524 (39.9%)	7 (58.3%)	39 (42.9%)
high school	783 (59.6%)	5 (41.7%)	52 (57.1%)
Marital status:			
married or cohabiting	823 (62.7%)	5 (41.7%)	49 (53.8%)
divorced, separated, widowed, or single	490 (37.3%)	7 (58.3%)	42 (46.2%)
Number of endorsed PLEs	1.4 (2.2), 0–23	5.0 (6.2), 0–19	2.1 (2.3), 0–12
PLE factor score	0.0 (1.0), −0.8–4.7	0.9 (1.8), −0.8–3.7	0.4 (1.0), −0.8–2.9
GHQ-12 sum score	23.0 (4.7), 12–45	27.3 (6.0), 18–41	25.2 (6.1), 15–43

GHQ-12, General Health Questionnaire-12.
PLE, Psychotic-like experience.

Basic education was dichotomized to "less than high school" and "high school"; further education was not considered since younger participants had often not completed it. Marital status was likewise dichotomized (Table 2).

We used Spearman rank-order correlations and Mann-Whitney *U* tests for descriptive analyses. Cox models were used to analyze whether the PLE factor predicted the two outcomes (psychosis and all mental disorders). Age, sex, education, and marital status were first controlled for, and in the following block, general psychological distress (GHQ-12 score) was added to the model. As a post hoc analysis, we also ran the analyses predicting all mental disorders *excluding psychotic disorders* to see whether the results would be explained by the psychotic disorders subsample. Hazard ratios (HR) with 95% confidence intervals (CI) are reported for the Cox models.

Finally, we looked at the individual PLEs as predictors of psychosis, with Cox models including one PLE at a time, again controlling for age, sex, education, marital status, and GHQ-12 score.

3. Results

3.1. Descriptive results

Table 2 presents the demographic information of the 1313 participants at baseline. During the 10–12 years of follow-up, 12 persons were diagnosed with a psychotic disorder (of which 9 during the five first years of follow-up). Any mental disorder was diagnosed for 91 participants (40 during the five first years), most commonly mood and anxiety disorders.

The number of endorsed experiences as well as the PLE factor score are shown in Table 2 for the whole sample and the subsamples who were diagnosed with psychotic or any mental disorder after the baseline assessment. At least one PLE was reported by 678 (51.6%) of the sample at baseline. At least one baseline PLE was endorsed by 7 (58.3%) of those with a later psychosis diagnosis and 66 (72.5%) of those with any later disorder.

Further analyses employed the latent PLE factor. Table 1 shows items 6 ("someone in love") and 7 ("jealousy") loading most poorly on the PLE factor, while item 14 ("special messages") functioned best, as it most strongly expressed the latent PLE factor. Item 3 ("people talking or laughing") was endorsed most frequently. Fig. 1 shows a scatterplot between factor scores and item endorsement probabilities. Especially in the case of few endorsed PLEs, the sum score was a poor indicator of the latent factor, as it did not take into account the varying item severities and loadings.

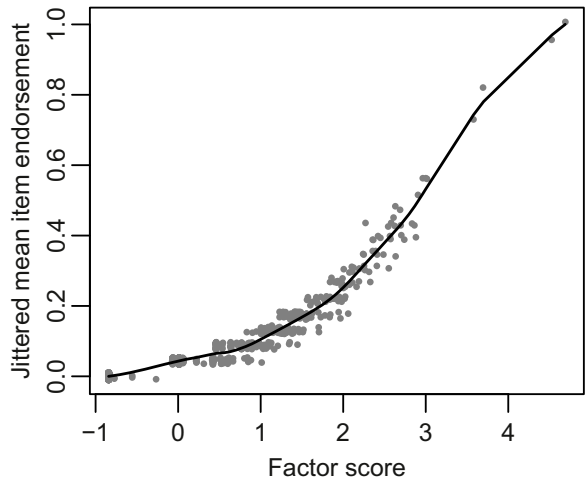

Fig. 1. Association between PLE factor scores and item endorsement probability. Note: Item endorsement refers to the portion of PLE items that are endorsed (with all PLEs endorsed at 1). A spline fit line is added for illustrative purposes.

Younger age was correlated with a higher PLE factor score ($r = -0.10$, $p < .001$). Females reported more PLE symptomatology than males (Mann-Whitney $U = 245\,630.5$, $p < .001$), as did those with lower educational level compared to those with a high school education ($U = 182\,132$, $p < .001$), and those divorced, separated, widowed, or single compared to those married or cohabiting ($U = 230\,331$, $p < .001$).

Higher GHQ-12 scores were associated with higher PLE score ($r = .26$, $p < .001$), female sex ($U = 238\,500$, $p < .001$), and not being married or cohabiting ($U = 233\,180.5$, $p < .001$), but not with age ($r = -0.04$, $p = .195$) or education ($U = 196\,955$, $p = .265$).

3.2. Predicting the outcomes with PLEs

The Cox models are presented in Table 3. A higher PLE factor score predicted subsequent psychotic disorders with a HR of 1.76 per standard deviation when controlling for age, sex, education, and marital status (model 1). Adding general psychological distress to the model lowered the predictiveness of PLEs to a nonsignificant level (model 2).

In predicting all mental disorders (model 3), PLEs (HR 1.39) and female sex were significant predictors, again adjusting for the demographic variables of age, education, and marital status. Further adjusting for general psychological distress did not affect the results, as PLEs remained predictive of a subsequent mental health diagnosis (HR 1.30; model 4). In post hoc analyses, PLEs predicted *all non-psychotic mental disorders* ($n = 86$) with an HR of 1.31 ($p = .007$).

Table 1 shows that of the individual PLEs, the best predictors of psychosis were items 22 ("unable to move"), 20 ("strange tastes"), 15 ("meant only for you"), and 16 ("strange forces").

4. Discussion

PLEs reported by general population young adults predicted both psychotic and other psychiatric diagnoses in specialized outpatient care and inpatient care in the following 10–12 years. The association between PLEs and later psychosis was not explained by age, sex, basic education level, or marital status, but including general psychological distress reported by the participants in the model weakened the association. In the case of all mental disorders, PLEs along with female sex were significant predictors, independently from age, basic education level, marital status, and general psychological distress.

Half of the young adults from the general population reported at least one PLE, the prevalence being high compared to many earlier studies (Linscott and van Os, 2013; McGrath et al., 2015), reflecting differences in assessment methods (Lee et al., 2016). However, we took into the account the varying relevance of the different PLEs. As can be seen in Table 1, some of the PLEs were common experiences loading comparatively weakly on the latent factor, thus not measuring the phenomena as accurately as some of the more rarely experienced perceptions or thoughts. The latent factor used in the analyses reflects the intensity of PLEs experienced by the young adults, a higher PLE factor score being associated with younger age, female sex, lower educational level, and not being married or cohabiting.

Self-reported PLEs reported as young adults added risk for subsequent psychotic disorders, in line with our main hypothesis. The most predictive single PLEs assessed catatonic-like symptoms, olfactory hallucination-like experiences, and experiences akin to delusions of reference. It has similarly been found in the earlier literature (Linscott and van Os, 2013) that people reporting PLEs have a heightened risk to proceed on the psychosis continuum towards the psychotic threshold, and that the non-clinical phenotype of experiencing PLEs shares risk factors and genetic variation with psychotic disorders (Kelleher and Cannon, 2011; van Os et al., 2000). At the same time, it should be noted that in the current study, some of the participants with later psychosis treatments did not report any PLEs at the time of filling in the

Table 3
Cox models predicting psychosis (models 1 and 2) or any mental disorder (models 3 and 4). Reference categories in parentheses.

Psychosis	**Model 1**			**Model 2**		
	B	**HR (95% CI)**	***p***	**B**	**HR (95% CI)**	***p***
PLE factor score	0.57	1.76 (1.11–2.80)	0.016	0.47	1.61 (0.98–2.63)	0.060
Sex (male)	0.68	1.98 (0.58–6.80)	0.279	0.54	1.72 (0.50–5.94)	0.391
Age	0.01	1.01 (0.86–1.18)	0.916	0.01	1.01(0.87–1.18)	0.876
Marital status (married or cohabiting)	0.70	2.01 (0.59–6.85)	0.262	0.54	1.72 (0.49–5.96)	0.396
Basic education (low education)	−0.70	0.50 (0.15–1.63)	0.248	−0.60	0.55 (0.17–1.82)	0.328
GHQ-12 sum score	–	–	–	0.08	1.09 (0.99–1.18)	0.069
Any mental disorder	**Model 3**			**Model 4**		
	B	**HR (95% CI)**	***p***	**B**	**HR (95% CI)**	***p***
PLE factor score	0.33	1.39 (1.16–1.67)	< 0.001	0.26	1.30 (1.08–1.58)	0.007
Sex (male)	0.91	2.49 (1.54–4.01)	< 0.001	0.85	2.34 (1.45–3.78)	< 0.001
Age	0.04	1.04 (0.98–1.10)	0.167	0.04	1.04 (0.98–1.11)	0.156
Marital status (married or cohabiting)	0.41	1.50 (0.97–2.32)	0.067	0.32	1.37 (0.88–2.13)	0.162
Basic education (low education)	−0.19	0.83 (0.54–1.27)	0.392	−0.14	0.87 (0.57–1.34)	0.539
GHQ-12 sum score	–	–		0.06	1.06 (1.02–1.10)	0.003

GHQ-12, General Health Questionnaire-12.
HR, Hazard ratio.
PLE, Psychotic-like experience.

questionnaire (false negatives); they may, however, have experienced prodromal PLEs later, before their first psychosis episode, as the follow-up period was long. Concerning false positives, it is known that a majority of PLEs do not develop to reach a psychotic level, and in most cases, PLEs are transient (Hanssen et al., 2005). Given the false negatives and positives, the clinical significance of the increased risk indicated by PLEs is limited.

PLEs also predicted all mental disorders, mostly mood and anxiety disorders, verifying the role of PLEs as a general clinical vulnerability marker of prognostic importance. This finding was not explained by the psychotic disorders subgroup, as the results remained the same when including only non-psychotic mental disorders. An earlier study, similarly using a register follow-up of young adults, reported a comparable finding of PLEs predicting psychosis and, with a weaker OR, any psychiatric hospitalizations, when controlling for age, sex, education, and ethnic background (Werbeloff et al., 2012). Another study found the associations between PLEs and mental disorders to be bidirectional, as most mental disorders also added risk for subsequent PLEs (McGrath et al., 2016). A shared genetic background may partly explain the transdiagnostic associations between the psychosis continuum and mental disorders in general (Barkhuizen et al., 2020; Legge et al., 2019). It has been suggested that psychotic phenomena are not a separate category of mental illness, but more accurately a nonspecific feature manifesting across the diagnostic spectrum (Kelleher and Cannon, 2016). Multiple disorders may thus share the same risk factors, and all mental disorders may even be seen to form just one underlying dimension (Caspi and Moffitt, 2018).

Taking into account the GHQ-12 score separates this work from many previous studies, the predictive information of PLEs being independent of general mental health distress. Also the GHQ-12 is good at detecting many different common mental disorders (Anjara et al., 2020), consistent with the above-mentioned one-dimensionality model. GHQ-12 is a widely used screening measure used to detect current psychological strain in the general population. In our study, higher GHQ-12 scores were correlated with higher PLE intensity, and the association between PLEs and psychosis outcomes seemed to be partially explained by general psychological distress. However, this could partly have resulted from the small number of general population participants in our sample having this rare outcome. In predicting all mental disorders, reported PLEs remained a stronger predictor than general psychological distress as measured with the GHQ-12. Of note, the GHQ can also be seen as controlling for response style in self-reported symptoms.

In our prediction models, we controlled for sociodemographic factors formerly found to correlate with PLEs. Sex, age, education, or marital status did not predict treatments for psychosis. In predicting any register-based psychiatric disorders, however, female sex added risk for a disorder. The mental disorders most commonly arising in the follow-up were depressive and anxiety disorders, which in particular have been diagnosed more often in females than males (Seedat et al., 2009). On the other hand, females also seek help for mental health concerns with a lower threshold compared to males (Haavik et al., 2017). In general, PLEs are associated with more mental health service use (Bhavsar et al., 2018; Murphy et al., 2012), which may affect the association between PLEs and having a mental health diagnosis. It should be noted that we did not account for all known risk factors linked to the psychosis continuum, such as genetic load, substance use, traumatic experiences, cognitive functioning, or negative symptoms (Addington and Heinssen, 2012; Dickson et al., 2012; Linscott and van Os, 2013; McGrath et al., 2017; Piskulic et al., 2012).

4.1. *Strengths and weaknesses*

A nationally representative sample of young adults and a long register follow-up were available in this study. Though some young adults chosen to the MEAF study were not reached, or they refused to reply or did not return the questionnaire, the response rate was acceptable. Questionnaire non-response has been analyzed previously, and was associated with older age, male sex, lower educational level, and a history of mental health hospital treatment (Suvisaari et al., 2009).

Reliable M-CIDI and GHQ-12 measures were used. The distress associated with PLEs was not inquired for, nor their timing, decreasing their information value. Recall bias may also have affected reporting of the PLEs. The PLE factor used in the study, however, reflected intensity of experiences, considering the items' varying endorsement frequency and loading on the latent factor, increasing the signal-to-noise ratio. Though several cutoffs have been suggested for the GHQ-12 (Goldberg et al., 1998), we used the GHQ-12 as a continuous variable due to concerns of any arbitrary cutoff causing missed information.

Good quality register data (Sund, 2012) was available, but diagnoses given in general practitioner or occupational health clinics are not included in the register data, which particularly affects the detection of milder mental health problems. Mental disorders that the participants had not sought treatment for and thus were undiagnosed were naturally missing from the register follow-up. The age distribution of the participants may have affected the number of new disorders during the follow-up and hence the effect sizes: our mean baseline age was 28 years, but mental disorders often emerge at a younger age (Solmi et al., 2021).

4.2. Conclusions

In a prospective study of young adults, representative of the general population, PLEs were a marker of vulnerability to psychotic disorders and all mental disorders during the following decade. PLEs added predictive information beyond the GHQ-12 questionnaire, and paying attention to PLEs seems beneficial for early detection in mental health risk assessment and targeting support and services.

Contributors

ML, LN, AT-H: study plan. ML, MH, ST, LN, AT-H: analysis plan. ML, LN, ST: statistical analyses. ML, LN: literature searches. ML: first draft of the manuscript. All authors contributed to and have approved the final manuscript.

Declaration of competing Interest

None.

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