The Journal of Child Psychology and Psychiatry

Journal of Child Psychology and Psychiatry **:* (2025), pp **–** doi:10.1111/jcpp.70007

Youth psychotic experiences: psychometric evaluation and diagnostic associations of the CAPE-16 in adolescents from the Norwegian Mother, Father and Child Cohort

Viktoria Birkenæs,[1] Pravesh Parekh,[1] Laura Hegemann,[2,3,4] Nora R. Bakken,[1] Evgeniia Frei,[1] Piotr Jaholkowski,[1] Olav B. Smeland,[1] Ezra Susser,[5,6] Katrina M. Rodriguez,[6] Markos Tesfaye,[1,7] Ole A. Andreassen,[1,8] Alexandra Havdahl,[2,3,9†] and Ida E. Sønderby[1,8,10†]

[1]Division of Mental Health and Addiction, Centre for Precision Psychiatry, University of Oslo and Oslo University Hospital, Oslo, Norway; [2]PsychGen Center for Genetic Epidemiology and Mental Health, Norwegian Institute of Public Health, Oslo, Norway; [3]Nic Waals Institute, Lovisenberg Diaconal Hospital, Oslo, Norway; [4]Department of Psychology, University of Oslo, Oslo, Norway; [5]Department of Epidemiology and Psychiatry, Mailman School of Public Health, Columbia University, New York, NY, USA; [6]New York State Psychiatric Institute, New York, NY, USA; [7]Department of Clinical Science, University of Bergen, Bergen, Norway; [8]KG Jebsen Centre for Neurodevelopmental Disorders, University of Oslo, Oslo, Norway; [9]Department of Psychology, PROMENTA Research Center, University of Oslo, Oslo, Norway; [10]Department of Medical Genetics, Oslo University Hospital, Oslo, Norway

Background: Adolescent self-reported psychotic experiences are associated with mental illness and could help guide prevention strategies. Youth report substantially more experiences than adults. However, with large societal changes like the digital revolution and COVID-19 pandemic, existing questionnaires may no longer accurately capture youth experiences. We aimed to determine the ability of the CAPE-16 questionnaire in capturing psychotic experiences across contexts (biological sex and COVID-19 response) and generations, thereby validating important psychometric aspects of the tool in modern adolescents. **Methods:** We used data from the Norwegian Mother, Father and Child Study (MoBa), a population-based pregnancy cohort. Adolescents responded to the CAPE-16 questionnaire (n = 18,835). For a comparison between age groups, we included adult men from the parent generation who responded to the CAPE-9 (n = 28,793). We investigated the psychometric properties of CAPE-16 through confirmatory factor analyses, measurement invariance testing across biological sex, response before/during the COVID-19 pandemic, and generations (adolescents and fathers), and examined subscale and item-level associations with subsequent registry-based psychiatric diagnoses (average time between CAPE and last registry update: 3.68 ± 1.34 years). **Results:** Out of 18,835 adolescents, 33.2% reported lifetime psychotic experiences. We confirmed a three-factor structure (paranoia, bizarre thoughts, and hallucinations) and good subscale reliability (ω = .86 and .90). CAPE-16 scores were stable across biological sex and pandemic status. CAPE-9 response patterns were non-invariant across adolescents and adult men, with an item related to digital technology particularly prone to bias. CAPE-16 subscales were associated with subsequent psychiatric diagnoses, especially psychotic disorders. **Conclusions:** CAPE-16 is a reliable measure of psychotic experiences across sex and a major societal stressor in adolescents. More frequent and distressing experiences increase the risk of subsequent psychiatric diagnoses. Different response patterns between adults and adolescents for items related to digital technology suggest differences in interpretation. Hence, certain items may benefit from revisions. **Keywords:** Youth psychotic experiences; subgroup differences; subsequent mental illness; digitalization; COVID-19; MoBa.

Introduction

Psychotic experiences (PEs) are delusions and hallucinations that do not reach the clinical threshold for a psychotic episode (Linscott & Van Os, 2013). The estimated prevalence of PEs is around 8%–17% in children and adolescents (Kelleher et al., 2012) compared to 5%–10% in adults (Linscott & Van Os, 2013; McGrath et al., 2015). Hence, psychosis is suggested to exist on a continuum with psychotic experiences at one end and frank psychosis at the other (Johns & Van Os, 2001). In adults, PEs are associated with both concurrent and subsequent mental illness (McGrath et al., 2016). Similarly, in youth, PEs indicate a four-fold increased risk for psychosis and a three-fold increased risk for non-psychotic mental illness (Healy et al., 2019). These associations position adolescent PEs as potential targets for early detection and intervention. Yet, to identify clinically relevant PEs, we need valid and reliable PE questionnaires.

During the past decade, adolescents, and particularly adolescent girls, have reported increasing affective symptoms (Campbell, Bann, &

†These authors contributed equally to this work.

Conflict of interest statement: See Acknowledgements for full disclosures.

Patalay, 2021) – a problem seemingly exacerbated by the COVID-19 pandemic (Madigan et al., 2023). The pandemic offers a unique opportunity to study PE changes during a major societal stressor, with several studies now showing increased reports of PEs after the onset of the pandemic (DeVylder et al., 2024; Oh et al., 2021; Wang, Zhou, Chen, & Sun, 2023). However, changes in prevalence do not give us the complete picture. Investigating whether reports of PEs are comparable across adults and adolescents also entails testing if responses are consistent within adolescents. We need to make sure that observed differences stem from context (i.e. the pandemic) or subgroup (i.e. boys and girls) factors rather than measurement inconsistencies. For instance, large variations in responses to the same question within groups may indicate different interpretations. Questionnaire variability can be assessed through invariance testing, which evaluates whether group differences are solely due to differences in scaling (i.e. one group simply reports more symptoms) or variation in the *pattern* of responses (Putnick & Bornstein, 2016). While preliminary evidence suggests that CAPE measures PEs similarly across gender (Aloba & Opakunle, 2020), knowledge about sex differences remains limited. Further, we lack information on whether CAPE response patterns are stable before and during the COVID-19 pandemic or across individuals that grew up before or after the digital revolution. Invariance testing can help us identify whether reports are comparable and thus confirm group differences.

Children reporting PEs have an increased likelihood of adult-onset psychotic and non-psychotic mental conditions (Fisher et al., 2013; Niarchou, Zammit, & Lewis, 2015; Sullivan et al., 2020). So far, diagnostic associations of item-level PEs remain largely unexplored, with a few exceptions (Lindgren, Numminen, Holm, Therman, & Tuulio-Henriksson, 2022; McGrath et al., 2015). If CAPE-16 items truly capture psychosis-related phenomena, we would expect positive relationships between items and subsequent psychiatric diagnoses, particularly psychosis, further validating important psychometric aspects of the scale. Investigating item-specific diagnostic associations can also provide insight into the nuances of adolescent responses.

The current work explores several novel aspects. Given reports of increasing youth mental health issues (Campbell et al., 2021; Evensen et al., 2023; Keyes, Gary, O'Malley, Hamilton, & Schulenberg, 2019), we aimed to investigate whether there are substantial changes in CAPE psychometric structure and clinical associations across generations, during a major societal incident (COVID-19 pandemic), and between sexes. This approach gives insight into whether PE reports can be accurately compared across groups and sheds light on why modern adolescents might respond differently to a PE self-report questionnaire compared to the parent generation.

We examined CAPE-16 psychometric properties by: (a) investigating factor structure and scale reliability, (b) assessing measurement invariance across biological sex, response before/during COVID-19, and generations (adolescent-adult and adolescent-father comparisons), and (c) examining associations between CAPE-16 (subscale and item-level) and subsequent registry-based psychiatric diagnoses. While prior studies have investigated CAPE factor structure and scale reliability (Capra, Kavanagh, Hides, & Scott, 2017; Mark & Toulopoulou, 2016; Sun et al., 2020), we extend these findings by examining response pattern stability across sex, a major societal stressor (the COVID-19 pandemic), and two generations. This investigation of response pattern differences is crucial for accurate group mean comparisons and to avoid spurious relationships with clinical outcomes. By validating important psychometric aspects of CAPE-16, we aimed to assess its utility in identifying psychosis continuum experiences across various contexts, thereby informing future research on the prediction and early identification of psychosis.

Methods

Participants

MoBa is a population-based pregnancy cohort study conducted by the Norwegian Institute of Public Health. Participants were recruited from all over Norway from 1999–2008. Out of the total number of pregnant women invited, 41% agreed to participate. Fathers were first invited at week 15 of the pregnancy (Magnus et al., 2006, 2016). All participants provided informed written consent. Formation of MoBa and initial data collection were based on a license from the Norwegian Data Protection Agency and approval from the Regional Committees for Medical and Health Research Ethics (REK). The Norwegian Health Registry Act regulates MoBa, and REK has approved the current study (2016/1226/REK Sør-Øst C). 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 2013.

Measures

Sociodemographic variables. Information about sex assigned at birth, birth year and weight, parity, and parent's age at birth was collected from the Norwegian Medical Birth Registry. Parents reported income and educational attainment in the baseline MoBa questionnaires (week 15 of pregnancy).

Symptom measures. Between 2016 and 2022, all MoBa children (14 years at sampling) received health and lifestyle questionnaires. In total, 21,122 adolescents responded to the questionnaires, including CAPE-16 (complete cases: $n = 18{,}835$). CAPE-16 comprises CAPE-15 and an additional item from CAPE-9 (details in Tables S1 and S2). The CAPE-9 scale was developed from the CAPE 20-item positive subscale (Stefanis et al., 2002) by comparing the performance of items in predicting psychosis onset in the TRAILS longitudinal cohort

(Jim van Os, personal communication). Each scale item is rated on a 4-point scale for both frequency of experiences and related distress ('never', 'sometimes', 'often', 'nearly always'). We defined our PE cut-off as scoring 'often' or 'nearly always' on one or more questions in accordance with previous studies (Fekih-Romdhane et al., 2021, 2024). During 2015, MoBa fathers responded to CAPE-9 (complete cases n = 28,793). We gave an in-depth description of the adult men sample elsewhere (Birkenæs et al., 2023). For adolescent-adult comparisons, we selected the items comprising CAPE-9 from CAPE-16. Because of competing measures, MoBa did not include the CAPE in questionnaires to the participating mothers.

Emotional symptoms. The Symptoms Checklist-10 (SCL-10; Table S3) was developed for MoBa by regressing the items of SCL-25 on total scores in the available data. This shorter version was then validated in an adult sample (Tambs & Moum, 1993; Tambs & Røysamb, 2014).

Psychiatric diagnoses. Psychiatric diagnoses were derived from the Norwegian Patient Registry, a national health care registry containing ICD-10 (World Health Organization, 2004) codes from hospitals, contract specialists, and outpatient clinics in all municipalities of Norway. Note S1 gives an in-depth description of NPR. Diagnostic information was available from January 2008 to December 2023. Diagnoses included in the analyses were psychotic disorders (F20, F22, F23, F25, F28, F29), depressive episodes (F32), bipolar disorder (F31), phobias (F40), anxiety disorders (F41), obsessive-compulsive disorder (OCD; F42), trauma- and stressor-related disorders (F43.0, F43.1, F43.2), somatoform disorder (F45), eating disorders (F50) and personality disorders (F60) (counts in Table S5a,b).

Statistical analyses

All analyses were performed in R, version 4.0.3 (R Core Team, 2020). We randomly removed one of each sibling pair to avoid relatedness among participants (sample selection described in Figure S1).

Scale reliability and confirmatory factor analysis. A prior meta-analysis estimated the CAPE positive subscale (CAPE-20) to have a mean Cronbach's alpha of 0.84 ± 0.1 (Mark & Toulopoulou, 2016). To evaluate the scale reliability of the CAPE-16 subscales, we used the omega coefficient, which is more robust to skewed data than the alpha (McNeish, 2018). We conducted confirmatory factor analyses (CFA) based on the previously observed three-factor structure of CAPE-15 (Mark & Toulopoulou, 2016) and CAPE-9 (Birkenæs et al., 2023). To handle violations of normality, we used a robust maximum likelihood estimator (Yuan & Bentler, 1998).

Measurement invariance testing. We tested measurement invariance (MI) across group status (boys/girls, response before/during COVID-19, adolescents/adult men from the parent generation). MI analysis was used to evaluate if CAPE captured the same construct across the specified groups. This approach is used to ensure that any observed difference in mean scores between groups is indicative of actual differences and not merely differences in interpretation of the questions or response style (Chen, 2008). The method involves testing models with increasingly strict parameter constraints to evaluate if parameters are equal across groups. We first tested the replicability of the factor structure (configural model), then constrained factor loadings to be equal across groups (metric invariance), and lastly constrained both intercepts and loadings (scalar invariance; Putnick & Bornstein, 2016). We also ran a post-hoc invariance test comparing only men and adolescent boys to evaluate any sex-specific effects. Here, relatedness between the men and boys was not specified. To avoid severe imbalance between sample sizes, we randomly drew a sample of men equal to that of the number of boys (~9,000). Finally, we ran post-hoc analyses restricting to related pairs of fathers and children (i.e. pairs sharing the same family ID).

We evaluated the configural model based on overall model fit, with a good fit indicated by comparative fit index (CFI) and Tucker Lewis index (TLI) >.95, root mean square error of approximation (RMSEA) <.06, and standardized root mean square residual (SRMR) <.08. To evaluate metric and scalar invariance, we compared models by estimating change in model fit. Due to the large sample size, we used a stricter cut-off: ≥−.01 for ΔCFI and ΔTFI, ≥.015 in ΔRMSEA and ≥.030 in ΔSRMR for metric invariance, and ≥.015 in ΔSRMR for scalar invariance (Putnick & Bornstein, 2016).

Lastly, we assessed partial MI, which involves trying to establish invariance among a subset of specified parameters if the complete model is not established. The model parameters used to test partial invariance were based on modification indices (i.e. the amount the chi-square fit would reduce if the constraint on that parameter were removed; Putnick & Bornstein, 2016). Unequal samples may result in less sensitive MI tests (Yoon & Lai, 2018). Hence, as an additional sensitivity test, we randomly drew adults to create a sample matching the number of adolescents.

CAPE-16 and subsequent psychiatric diagnoses. We performed binomial logistic regression to test whether adolescents' CAPE-16 sum scores and individual item scores were associated with later registry-based psychiatric diagnoses. To enable comparison of odds ratios, we standardized the frequency and distress sum scores with Z-transformation. To avoid temporal overlap between CAPE response and diagnoses, we only included diagnoses set 6 months or more after the adolescent responded to CAPE. Individuals who received one of the specified diagnoses before this cut-off were removed from analyses (n = 456). The average time between CAPE response and diagnostic follow-up end point was 3.68 ± 1.34 years, ranging from 6 months to 7 years.

Emotional symptoms, like anxiety and depression, may accompany PEs (Wilson, Yung, & Morrison, 2020). These can also affect the measurement accuracy of screening tools (Naicker, Norris, & Richter, 2021) and lead to biased associations between PEs and psychiatric diagnoses. For instance, individuals with high current negative affect tend to overestimate other lifetime mental symptoms (Van Den Bergh & Walentynowicz, 2016). We aimed to assess the effectiveness of CAPE-16 in identifying experiences on the psychosis continuum beyond emotional symptoms. Hence, we included the SCL-10 sum scale as a covariate.

p-Values were adjusted for multiple comparisons using Benjamini-Hochberg correction (Benjamini & Hochberg, 1995). Approximately 23% (n = 21,211) of the total original MoBa children participated in the current wave. Therefore, to evaluate potential attrition bias, we re-ran our logistic analyses with inverse probability weights (IPW; described in Note S1).

Results

Sample characteristics

Out of 18,835 adolescents, 53.7% (n = 10,118) were registered as female at birth. The mean age at CAPE response was 14.4 ± 0.51 years. In the youth

sample, 14% reported lifetime nicotine use, 17% alcohol, 1.4% cannabis, and 1.3% other lifetime drug use. Respondents and their parents had fewer psychiatric diagnoses than MoBa participants who did not respond to this wave of questionnaires, and parents of respondents were older and more highly educated than parents of non-respondents (Tables S4 and S5). Figure S1 shows the sample selection process. In the adult men (n = 28,793), the mean age at CAPE response was 42.4 ± 5.6 years (Birkenæs et al., 2023).

Scale reliability and confirmatory factor analysis

Omega estimates were .86 and .90 for the frequency and distress subscales, respectively, suggesting excellent scale reliability (McDonald, 2013).

Table 1 provides CFA estimates for all subgroups. The CAPE-16 frequency and distress scales showed a good fit with the proposed three-factor structure: persecutory ideation, bizarre thoughts, and hallucinations (Mark & Toulopoulou, 2016). The factors were replicated across biological sex, pandemic status, and generations.

Measurement invariance across biological sex, pandemic status, and generations

We found evidence for full measurement invariance (i.e. no significant difference in factor structure or loadings) across biological sex (girls, n = 10,118; boys, n = 8,717) and pandemic status (before onset, n = 9,339; after, n = 9,496) for both subscales, indicating that responses were comparable across groups (Table 2). This suggests that the difference in means across these groups are due to actual PE group differences and not due to individuals in the groups interpreting the questions differently. We also found evidence for metric, but not scalar, invariance in CAPE-9 subscales across adolescents (n = 18,835) and adult men (n = 28,793), indicating that while the factor structure and loadings were similar, the intercepts were not. This suggests that the CAPE questions are interpreted differently by adolescents and adults. Observing the modification indices suggested that freeing the equality constraint between youth and adult groups for the *electrical influence* item intercept might improve model fit for both subscales. However, while freeing this parameter improved model fit, we were not able to establish partial scalar invariance. Main estimates are presented in Table 2. Evidence from the post-hoc analyses comparing only adult men with adolescent boys and across linked pairs of fathers and their children showed the same scalar non-invariance, supporting measurement non-equivalence across youth and adults. The estimates are presented in Table 3. Matched sample sizes suggested a negligible effect of unequal sample size on measurement invariance estimates (Table S6).

Psychotic experiences in adolescent sub-samples. One third of adolescents reported experiencing one or more PEs 'often' or 'nearly

Table 1 Confirmatory factor analyses in all sub-groups

	χ^2 (*df*)	CFI	TLI	RMSEA (95% CI)	SRMR
CAPE-16					
Frequency, n = 18,835	1,390.13 (101)	.991	.989	.028 (.026–.029)	.039
Distress, n = 18,835	1,453.42 (101)	.992	.991	.027 (.025–.028)	.044
Boys, n = 8,717					
Frequency	280.48 (101)	.988	.985	.015 (.013–.017)	.030
Distress	199.75 (101)	.990	.988	.011 (.008–.013)	.036
Girls, n = 10,118					
Frequency	651.30 (101)	.983	.979	.025 (.022–.026)	.033
Distress	586.20 (101)	.984	.981	.022 (.020–.024)	.036
Pre-pandemic, n = 9,339					
Frequency	438.11 (101)	.984	.981	.021 (.019–.023)	.033
Distress	461.72 (101)	.981	.978	.019 (.017–.021)	.040
During COVID-19, n = 9,496					
Frequency	489.30 (101)	.987	.985	.021 (.019–.022)	.031
Distress	364.0 (101)	.990	.988	.017 (.015–.019)	.035
CAPE-9					
Fathers, n = 28,793					
Frequency	325.08 (24)	.989	.983	.021 (.019–.023)	.044
Distress	55.15 (24)	.973	.959	.007 (.004–.008)	.041
Adolescents, n = 18,835					
Frequency	575.18 (24)	.989	.983	.035 (.032–.037)	.040
Distress	540.70 (24)	.992	.988	.033 (.030–.035)	.042

Separate confirmatory factor analyses were conducted in each sample and on both sub-scales. CFI, comparative fit index; RMSEA, root mean square error of approximation; SRMR, standardized root mean square residual; TLI, Tucker-Lewis index (TLI).

Table 2 Measurement invariance testing across biological sex, pandemic status and generations

Model	χ^2 (*df*)	CFI	TLI	RMSEA (95% CI)	SRMR	$\Delta\chi^2$ (Δdf)	ΔCFI	ΔTLI	ΔRMSEA	ΔSRMR	Decision
Frequency subscale											
A. CAPE-16: Boys versus girls											
M1: Configural Invariance	931.78 (202)	.984	.981	.021 (.019–.022)	.029	–	–	–	–	–	–
M2: Metric Invariance	1,087.59 (215)**	.981	.979	.022 (.021–.023)	.032	155.81 (13)**	−.003	−.002	.001	.003	Accept
M3: Scalar Invariance	1,427.05 (218)**	.974	.973	.025 (.024–.026)	.035	339.46 (13)**	−.007	−.006	.003	.003	Accept
B. CAPE-16: Pre- versus during COVID-19											
M1: Configural Invariance	927.41 (202)	.986	.983	.021 (.019–.022)	.030	–	–	–	–	–	–
M2: Metric Invariance	975.47 (215)**	.985	.983	.021 (.019–.022)	.031	48.07 (13)**	−.001	.000	.000	.001	Accept
M3: Scalar Invariance	1,060.68 (228)**	.984	.983	.021 (.020–.022)	.031	85.21 (13)**	−.001	.000	.000	.000	Accept
C. CAPE-9: Adults versus adolescents											
M1: Configural Invariance	486.52 (48)	.980	.970	.020 (.018–.022)	.027	–	–	–	–	–	–
M2: Metric Invariance	580.49 (54)**	.976	.968	.020 (.019–.022)	.035	93.97 (6)**	−.004	−.002	.001	.008	Accept
M3: Scalar Invariance	2263.07 (60)**	.899	.878	.039 (.038–.041)	.059	1682.57 (6)**	−.077	−.089	.019	.024	Reject
M3a: Partial Scalar Invariance	1037.97 (59)**	.955	.945	.026 (.025–.028)	.045	457.48 (5)**	−.021	−.023	.006	.010	Reject
Distress subscale											
A. Boys versus girls											
M1: Configural Invariance	785.95 (202)	.985	.982	.018 (.016–.019)	.034	–	–	–	–	–	–
M2: Metric Invariance	914.97 (215)**	.982	.980	.019 (.017–.020)	.037	129.02 (13)**	−.003	−.002	.001	.003	Accept
M3: Scalar Invariance	1,295.95 (228)**	.973	.971	.022 (.021–.023)	.040	380.97 (13)**	−.009	−.009	.004	.003	Accept
B. Pre- versus during COVID-19											
M1: Configural Invariance	805.73 (202)	.986	. 984	.018 (.017–.019)	.035	–	–	–	–	–	–
M2: Metric Invariance	901.08 (215)**	.984	.982	.018 (.017–.020)	.037	95.35 (13)**	−.002	−.002	.001	.002	Accept
M3: Scalar Invariance	1,003.24 (228)**	.982	.981	.019 (.018–.020)	.037	28.67 (13)**	−.002	−.001	.000	.000	Accept
C. CAPE-9: Adultsversus adolescents											
M1: Configural Invariance	306.49 (48)	.985	. 977	.015 (.013–.017)	.034	–	–	–	–	–	–
M2: Metric Invariance	338.65 (54)**	.983	.978	.015 (.013–.016)	.038	32.2 (6)*	−.002	.000	.000	.004	Accept
M3: Scalar Invariance	1,005.01 (60)**	.944	.933	.026 (.024–0.027)	.051	666.37 (6)**	−.039	−.045	.011	.013	Reject
M3a: Partial Scalar Invariance	568.36 (59)	.970	.963	.019 (.018–.020)	.042	229.71 (5)**	−.013	−.015	.004	.004	Reject

Measurement invariance testing with nested model comparisons. Cut-off values used: −.01 deviation cut-off for CFI and TFI, and .015 in RMSEA and .030 in SRMR for metric invariance; .015 in SRMR for scalar invariance. In the partial invariance model, we freed the intercept of item 4. A. Boys n = 8,717; girls n = 10,118. B. Pre-COVID n = 9,339; during COVID n = 9,496. C. Adolescents n = 18,835; Adult men n = 28,793. CFI, comparative fit index; RMSEA, root mean square error of approximation; SRMR, standardized root mean square residual; TLI, Tucker Lewis index (TLI).

* $p \leq .01$, ** $p \leq .001$.

Table 3 Measurement invariance testing across adolescents and adult men

Model	χ^2 (*df*)	CFI	TLI	RMSEA (95% CI)	SRMR	$\Delta\chi^2$ (Δdf)	ΔCFI	ΔTLI	ΔRMSEA	ΔSRMR	Decision
Frequency sub-scale											
A. CAPE-9: Men versus boys											
M1: Configural Invariance	146.53 (48)	.985	.977	.015 (.012–.018)	.025	–	–	–	–	–	–
M2: Metric Invariance	163.77 (54)**	.983	.978	.015 (.012–.017)	.030	17.24 (6)**	−.002	.001	.000	.005	Accept
M3: Scalar Invariance	879.04 (60)**	.874	.849	.038 (.036–.041)	.062	715.27 (6)**	−.109	−.129	.023	.032	Reject
B. CAPE-9: Fathers versus children											
M1: Configural Invariance	242.59 (48)	.980	.971	.021 (.019–.024)	.029	–	–	–	–	–	–
M2: Metric Invariance	281.31 (54)**	.977	.969	.022 (.019–.024)	.037	38.72 (6)**	−.003	−.003	.001	.008	Accept
M3: Scalar Invariance	1103.87 (60)**	.895	.874	.044 (.038–.041)	.059	822.56 (6)**	−.082	−.096	.022	.022	Reject
Distress subscale											
A. CAPE-9: Men versus boys											
M1: Configural Invariance	71.21 (48)*	.994	.991	.007 (.003–.011)	.031	–	–	–	–	–	–
M2: Metric Invariance	83.03 (54)**	.993	.990	.008 (.004–.011)	.035	11.83 (6)**	−.001	−.001	.001	.004	Accept
M3: Scalar Invariance	264.99 (60)**	.949	.939	.019 (.017–.022)	.049	181.97 (6)**	−.044	−.052	.012	.014	Reject
B. CAPE-9: Fathers versus children											
M1: Configural Invariance	154.38 (48)	.986	.979	.016 (.013–.019)	.035	–	–	–	–	–	–
M2: Metric Invariance	167.06 (54)**	.985	.980	.015 (.013–.018)	.039	12.68 (6)**	−.001	.001	.000	.004	Accept
M3: Scalar Invariance	486.46 (60)**	.944	.932	.028 (.026–.021)	.052	319.39 (6)**	−.041	−.048	.013	.012	Reject

Measurement invariance testing with nested model comparisons. Cut-off values used: −.01 deviation cut-off for CFI and TFI, and .015 in RMSEA and .030 in SRMR for metric invariance; .015 in SRMR for scalar invariance. CFI, comparative fit index; RMSEA, root mean square error of approximation; SRMR, standardized root mean square residual; TLI, Tucker Lewis index (TLI). A. Men n = 9,000; Boys n = 8,717. B. Fathers n = 8,755; Children n = 8,755.
*$p \leq .01$, **$p \leq .001$.

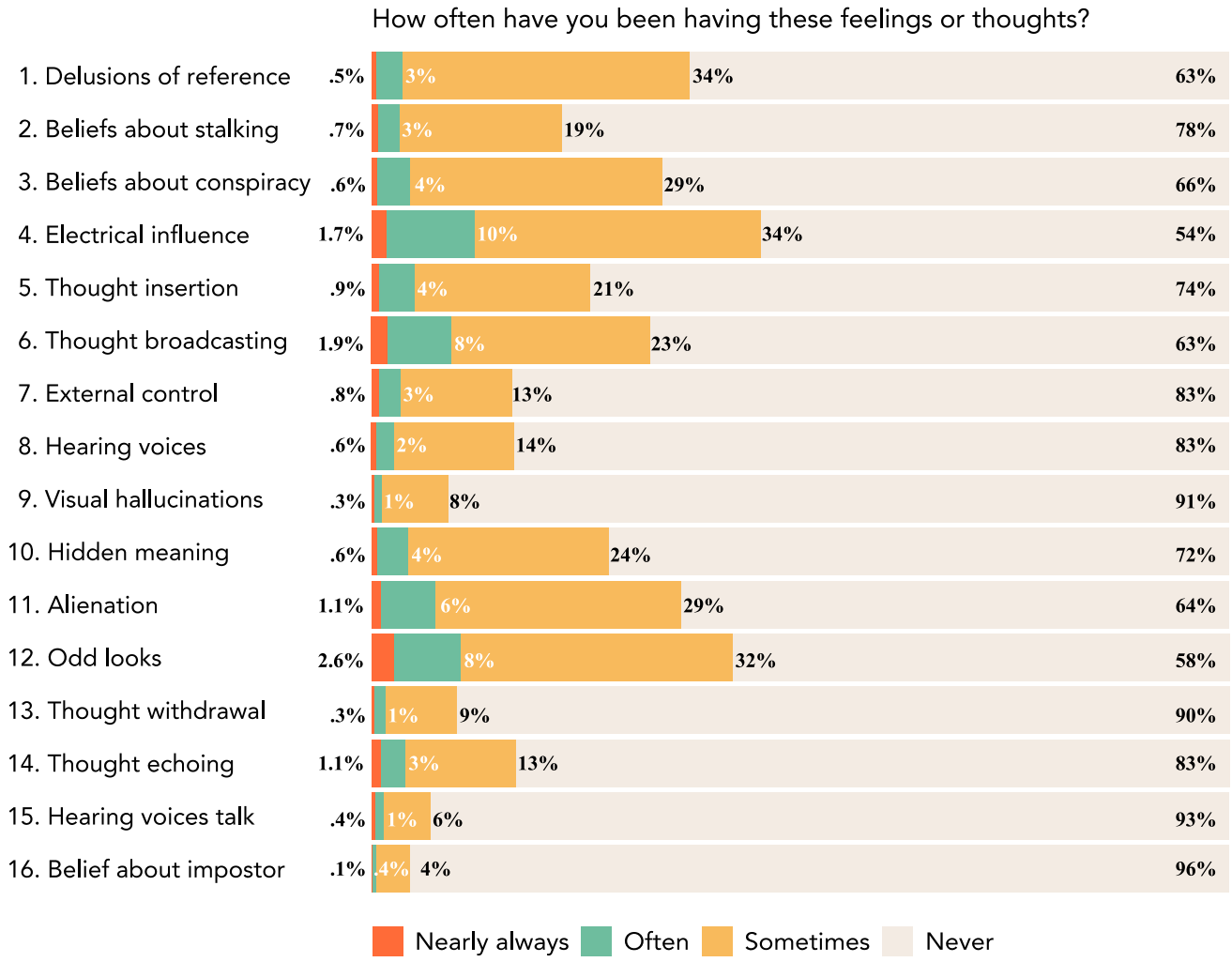

Figure 1 CAPE-16 frequency response patterns in MoBa adolescents. Percentage of individuals who gave a positive response to one of the four CAPE-16 response categories

always': 26.9% on CAPE-9 and 33.2% on the CAPE-16 (Figure 1; Table S2). Girls reported significantly more frequent ($r = .26$, $p < .0001$) and distressing ($r = .27$, $p < .0001$) PEs than boys. Younger adolescents had slightly higher CAPE-16 sum scores (frequency: $r = .05$, $p < .0001$; distress: $r = .04$, $p < .0001$). Those who responded after the onset of the COVID-19 pandemic also had marginally higher scores than those who responded before the pandemic (frequency: $r = .05$, $p < .0001$; distress: $r = .04$, $p < .0001$).

Associations between CAPE-16 sum scores and psychiatric diagnoses

Figure 2 shows associations between CAPE-16 sum scores and registry-based psychiatric diagnoses in adolescents. Table S7a,b provide detailed estimates.

Both the frequency and distress subscales were positively associated with all psychiatric diagnoses but slightly more with psychotic disorders (*frequency-psychosis*: OR = 2.06; 97.5% CI = 1.70–2.46; *distress-psychosis*: OR = 1.93; 97.5% CI = 1.63–2.26). After adjusting for current emotional symptoms, the scales were only positively associated with psychotic disorders (*frequency*: OR = 1.41; 97.5% CI = 1.06–1.83; *distress*: OR = 1.37; 97.5% CI = 1.06–1.73), with a nominally significant association with trauma and stress-related disorders and a negative association with phobias. Estimates from inverse probability weighted analyses were comparable to the non-weighted estimates (Table S8a,b).

Associations between CAPE-16 items and psychiatric diagnoses

Several frequency items (*hidden meaning, beliefs about stalking, thought insertion, odd looks and external control*) were positively associated with one or more diagnoses (Table S9a). Notably, *hidden meaning* was positively associated with psychotic disorders (OR = 2.50; 97.5% CI = 1.42–4.28), while *electrical influence* was negatively associated with several diagnoses.

Similarly, most distress items (*delusions of reference, beliefs about stalking and conspiracy, thought insertion, thought broadcasting, odd looks, external*

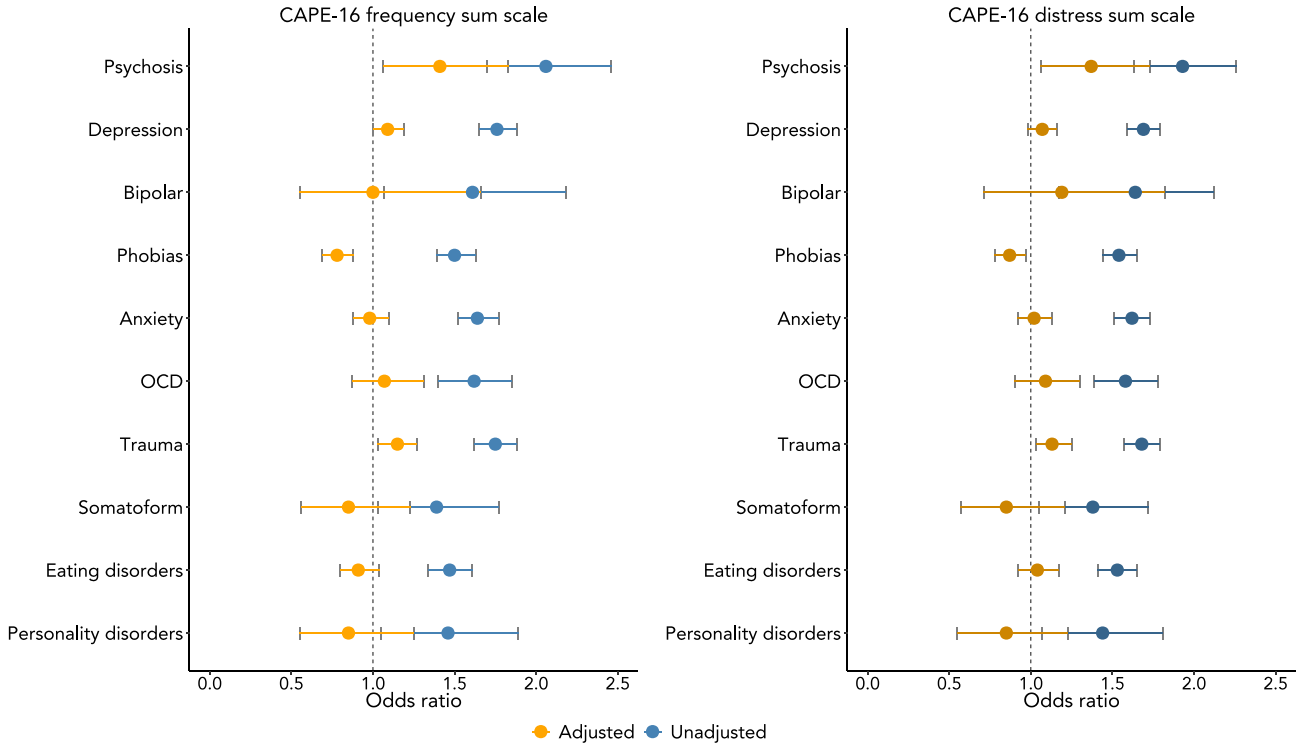

Figure 2 Associations between the CAPE-16 scales and psychiatric diagnoses—with and without adjustments for current anxiety and depressive symptoms. Binomial logistic regression with the CAPE-16 sum scales (ranging from 16 to 64, standardized to Z-scores to enable comparison between scales) and dichotomous diagnoses (yes/ no). Analyses with and without adjustments for current anxiety and depressive symptoms as measured with the SCL-10

control and *visual hallucinations*) were positively associated with multiple diagnoses (Table S9b), with *beliefs about stalking* most associated with psychotic disorders (OR = 1.93; 97.5% CI = 1.18–3.07). *Electrical influence* was negatively associated with depression and anxiety. For both the frequency and distress scales, most item-specific associations disappeared after adjustment for current emotional symptoms, with some exceptions (Table S9a,b).

Discussion

In this large population-based cohort, the CAPE-16 questionnaire demonstrated good scale reliability and replicated a previously observed three-factor structure (Mark & Toulopoulou, 2016). The CAPE-16 sub-scales were significantly associated with subsequent registry-based psychiatric diagnoses. We observed small differences in mean scores across sex and before versus during the COVID-19 pandemic. There were notable differences in *patterns* of responses between adolescents and adult men in the parent generation, specifically related to the *electrical influence* item ("Do you ever feel as if electrical devices can influence the way you think?"). These variances may be related to differences in attitudes to digital technology and a reflection of our increasingly digital society. These findings are also well-timed given recent reports of increasing youth mental health problems, particularly in the context of digital environments and aftermath of the COVID-19 pandemic. Together, our study supports CAPE-16 as a reliable tool for studying PEs in today's youth, but minor revisions may be needed.

Youth psychotic experiences across sex and pandemic status

Our measurement invariance testing indicated that scores were comparable across biological sex and pandemic status (i.e. response patterns were equivalent). This aligns with Barbosa et al. who found CAPE to be stable across gender (Barbosa et al., 2023). In our study, girls reported more PEs than boys, consistent with evidence that adolescent girls report more general mental health symptoms (Campbell et al., 2021) but perhaps incongruent with adolescent boys typically developing psychosis earlier than girls (Fusar-Poli et al., 2017). One interpretation may be that girls show greater mental health awareness and therefore share experiences more freely (Chandra & Minkovitz, 2006). Further, those responding during the COVID-19 pandemic reported slightly more frequent and distressing PEs than pre-pandemic respondents, which is consistent with increases in mental health issue reports after the pandemic onset and underlines the assumed mental burden of the pandemic (DeVylder et al., 2024; Madigan et al., 2023; Oh et al., 2021; Wang et al., 2023). CAPE-16 was invariant across

pandemic groups, suggesting that its psychometric properties were not significantly affected by this major societal stressor. Hence, within our sample, self-reported CAPE scores vary in terms of magnitude but not pattern of response across these subgroups.

Psychotic experiences across adults and adolescents

Previous studies suggest higher reports of PEs in youths than adults (Healy et al., 2019; Linscott & Van Os, 2013; McGrath et al., 2015). These differences may be due to adolescent developmental processes impacting cognition and emotion (Bentall, Fernyhough, Morrison, Lewis, & Corcoran, 2007). Differences may also be due to generational aspects, such as decreased youth mental health stigma (Deluca, 2020). Prior research has shown mean score differences in PE across family generations (Hanssen, Krabbendam, Vollema, Delespaul, & Van Os, 2006; Rimvall et al., 2024). Still, we need to be careful about how we attribute such variations.

Finding a substantial gap in PEs reported by MoBa adolescents versus adult men in MoBa (26.9% and 2.3% [CAPE-9]), we wanted to explore whether these differences extended beyond simple mean score variations. Measurement invariance is a prerequisite to compare mean group scores and failing to establish invariance may lead to incorrect conclusions about group differences (Chen, 2008). Here, responses in adults and adolescents were not only different in terms of magnitude, but also in response patterns. We found the same trend across related child-father pairs – which supports potential transgenerational pattern variations – as well as between men and boys, suggesting that the difference was not explained by sex. Specifically, factor loading variations suggest that adults and adolescents have different interpretations of the same questions. Therefore, comparing mean group differences is discouraged (Chen, 2008).

An example of how the pattern of responses differ is illustrated in the *electrical influence* item ("Do you ever feel as if electrical devices can influence the way you think?"), which showed large variability in estimated intercepts and endorsements (12.1% of adolescents vs. 0.4% of adult men). This item also showed consistent negative associations with psychiatric diagnoses in adolescents but not adults (Birkenæs et al., 2023). The item may capture how digital natives, like today's youth, perceive the impact modern technology has on daily life (e.g. personalized online ads and content). If so, this item would not accurately capture experiences on the psychosis continuum but rather different attitudes toward technology in the youth versus parent generation (Dingli & Seychell, 2015; Van Volkom, Stapley, & Malter, 2013). As such, this item might be revised to better reflect the day-to-day life of adolescents growing up in a digital world, although revising or omitting this item will require further validation and assessment of the revised scale.

Diagnostic associations

CAPE-16 sum scores were positively associated with all subsequent psychiatric diagnoses, particularly psychotic. This is in line with previous observations (Fisher et al., 2013; McGrath et al., 2016; Niarchou et al., 2015) and supports the validity of CAPE-16. However, the effect sizes were lower than those reported in a prior meta-analysis (e.g. association with psychotic disorders, OR = 2.06 versus pooled OR = 3.96 [Healy et al., 2019]). This difference may be attributed to our use of self-reports instead of clinician-led interviews, as well as the variability in time between CAPE responses and the most recent diagnostic registry updates that we had access to (3.68 ± 1.34 years), potentially leading to less robust estimates.

Adjusting for current emotional symptoms made associations more specific to psychotic disorders in accordance with our findings in MoBa fathers (Birkenæs et al., 2023). This suggests that CAPE-16 may indirectly capture emotional symptoms during reporting and that adjusting for these may improve predictive accuracy. One item was significantly associated with subsequent psychosis before adjustments. This item, *Hidden meaning* ("Have you ever had the feeling as if people drop hints about you or say things with a double meaning?"), falls within the persecutory ideation factor. Prior studies have also found that sub-clinical paranoid ideas and hallucinations are strongly associated with later psychosis. Interestingly, we did not observe an association between self-reported hallucinations and psychosis (Lindgren et al., 2022; Zammit et al., 2013). As of 2023, the median age of MoBa youth was 19 years. Given the typical onset of psychosis during early adulthood (Immonen, Jääskeläinen, Korpela, & Miettunen, 2017), individuals with psychotic disorders are likely underrepresented. Still, the associations did not appear substantially affected by attrition following our inverse probability assessments.

Strengths

The major strength of our study is the large, well-defined transgenerational sample with linkage to diagnostic registries and questionnaires administered on both sides of the COVID-19 pandemic. Previously understudied, we investigated item-specific diagnostic associations, evaluating both frequency and distress of experiences.

Limitations

The MoBa cohort limitations include its predominance of northern European, white participants and

loss to follow-up of individuals with severe mental illness (Vejrup, Magnus, & Magnus, 2022). Although inverse probability weighted estimates appeared unaffected by attrition bias, individuals with higher genetic risk for schizophrenia tend to drop out of large cohort studies (e.g. Martin et al., 2016), likely including MoBa (Biele et al., 2019). If PEs share genetic risk factors with psychotic conditions (Sieradzka et al., 2014; Zammit et al., 2014), this attrition may result in us capturing only milder cases on the psychosis continuum. Additionally, high-risk individuals are less likely to seek professional help and may be underrepresented in diagnostic registries (Skrobinska, Newman-Taylor, & Carnelley, 2024). While registry data lack detailed information that research protocols provide, the current registry provides comprehensive national public healthcare diagnoses that have been shown to be reliable and accurate (Note S1).

We tried to minimize temporal overlap between CAPE responses and diagnoses by excluding anyone diagnosed with one of the specified diagnoses prior to a six-month cut-off. However, this method is not without its limitations. CAPE responses may have been influenced by childhood onset conditions (e.g. neurodevelopmental). Furthermore, missing diagnostic information for some participants' first 8 years could have biased our estimates. Additionally, first-episode psychosis often remains undiagnosed for months or years (Salazar De Pablo et al., 2024), which could have led to some false negative cases in the association analyses. Finally, not including information on emigration or death in our analyses could have introduced bias. Future work should incorporate more nuanced time-sensitive modeling approaches and additional sources of information to explore the temporal relationship between psychotic experiences and psychiatric diagnoses. We were also unable to evaluate all psychometric aspects of CAPE. As a future validation step, comparing CAPE-16 with similar self-report measures, like the WHO CIDI psychosis sub-scale (Andrews & Peters, 1998) would be beneficial. Lastly, self-reports usually result in substantially higher prevalences than clinician rated interviews (Linscott & Van Os, 2013). However, individuals self-reporting PEs later deemed improbable by clinicians still demonstrate substantially higher risk for subsequent psychiatric diagnoses (Van Der Steen et al., 2019; Zammit et al., 2013).

Conclusion

With recent reports of increasing youth mental health issues, especially in the wake of the COVID-19 pandemic and the ongoing influence of widespread digitalization, current measures of psychotic experiences may be outdated for use in adolescents. In this large adolescent cohort, we found that CAPE-16, a measure of self-reported psychotic experiences, showed robust psychometric properties across biological sex and response before versus during the COVID-19 pandemic. We observed that adolescents and fathers showed different patterns of responses, warranting caution in interpreting group differences, particularly regarding questions involving digital technology. Adolescents who reported psychotic experiences at age 14 were more likely to later develop psychiatric illness, specifically psychotic disorders. Our findings support the use of CAPE-16 in modern adolescents but also highlight age-related differences in the reporting of psychotic experiences. Moving forward, associations between PEs, as measured with CAPE-16, and later diagnosis may be exploited in the prediction and early identification of psychosis.

Supporting information

Additional supporting information may be found online in the Supporting Information section at the end of the article:

Table S1. CAPE-16 questions – self-reported lifetime psychotic experiences.

Table S2. Distribution of psychotic experiences – responses to the frequency and distress CAPE-16 subscales in adolescents.

Table S3. The (Hopkins) Symptom Checklist (SCL-10).

Table S4a. Sociodemographic characteristics of adolescents who responded to CAPE-16.

Table S4b. Sociodemographic comparison between adolescent non-respondents and respondents.

Table S5a. Adolescents – Diagnostic counts: non-respondents and respondents.

Table S5b. Differences in diagnostic counts between the mothers and fathers of adolescent respondents and non-respondents.

Table S6. Matched sample sizes: test of measurement invariance across fathers and adolescents.

Table S7a. CAPE-16, frequency subscale: associations between psychiatric diagnoses and the CAPE-16 frequency subscale.

Table S7b. CAPE-16, distress subscale: associations between psychiatric diagnoses and the CAPE-16 distress subscale.

Table S8a. IPW: Associations between psychiatric diagnoses and the CAPE-16 frequency subscale with inverse probability weights.

Table S8b. IPW: Associations between psychiatric diagnoses and the CAPE-16 distress subscale with inverse probability weights.

Table S9a. CAPE-15 frequency items: Association between diagnoses and frequency items in adolescents.

Table S9b. CAPE-16 distress items: Association between diagnoses and distress items in adolescents.

Figure S1. Description of sample selection.

Figure S2. Comparison of CAPE-9 responses between adult males and adolescents.

Note S1. Description of the Norwegian Patient Registry.

Note S2. Inverse probability weighting.

Acknowledgements

The Norwegian Mother, Father and Child Cohort Study is supported by the Norwegian Ministry of Health and Care Services and the Ministry of Education and Research. The authors are grateful to all the participating families in Norway who take part in this ongoing cohort study. The authors would like to thank the Norwegian Institute of Public Health (NIPH) for generating high-quality genomic data. This research is part of the HARVEST collaboration, supported by the Research Council of Norway (#229624). We also thank the NORMENT Centre for providing genotype data, funded by the Research Council of Norway (#223273), Southeast Norway Health Authorities, and Stiftelsen Kristian Gerhard Jebsen. The authors further thank the Center for Diabetes Research, the University of Bergen for providing genotype data and performing quality control and imputation of the data funded by the ERC AdG project SELECTionPREDISPOSED, Stiftelsen Kristian Gerhard Jebsen, Trond Mohn Foundation, the Research Council of Norway, the Novo Nordisk Foundation, the University of Bergen, and the Western Norway Health Authorities. The current work was performed on Services for sensitive data (TSD), University of Oslo, Norway, with resources from UNINETT Sigma2—the National Infrastructure for High-Performance Computing and Data Storage in Norway. The authors want to thank Prof. Jim van Os for counseling during the initial implementation of CAPE in MoBa.

Prof. Andreassen has received speaker fees from Lundbeck, Janssen, Otsuka, and Sunovion and is a consultant to Cortechs.ai and Precision Health. None of the remaining authors have any conflicts of interest.

This project received funding from the European Union's Horizon 2020 Research and Innovation Programme (RealMent; #964874, CoMorMent project; Grant #847776; Marie Skłodowska-Curie grant; #801133), the European Economic Area and Norway Grants (EEA-RO-NO-2018-0535) NIMH (#5T32MH020004-24), the Research Council of Norway (#223273, #271555, #273291, #273446, #274611, #324499, #336085, and #324252), FAMILY (#101057529), the South-Eastern Norway Regional Health Authority (#2020060 and #2020022), and Kristian Gerhard Jebsen Stiftelsen (SKGJ-MED-021).

Author contribution

As lead author, VB has actively contributed to the conceptualization and design of the study, analysis, interpretation of the results, and writing of the manuscript. PP and LH contributed to the design of the study, data analyses and interpretation, as well as the revision of the manuscript. NRB, EF, PJ, OBS, ES, KMR and MT contributed to the conceptualization of the study, planning of analyses, and interpretation of results. OAA, AH and IES have, as supervisors to the primary author and lead researchers, provided substantial input in the conceptualization and design of the study, securing funding, and critically revising the manuscript. All authors have reviewed and approved the final version of the manuscript for submission and will be accountable for the accuracy and integrity of the work.

Transparency declaration

As the lead author of this paper, I (VB) take responsibility for the content, methodology and findings presented in the manuscript and affirm that these are an accurate account of our research. No important aspects of the study have been omitted.

Ethical information

All participants provided informed written consent. Formation of MoBa and initial data collection were based on a license from the Norwegian Data Protection Agency and approval from the Regional Committees for Medical and Health Research Ethics (REK). The Norwegian Health Registry Act regulates MoBa, and REK has approved the current study (2016/1226/REK Sør-Øst C).

Data availability statement

The code used for data management and analysis used in this study are available on request from the corresponding author. Access to raw data can be requested via direct application to NIPH and MoBa. For requirements and other information, see: https://www.fhi.no/en/ch/studies/moba/for-forskere-artikler/research-and-data-access/. The protocols and consent forms used for data collection can be found here: https://www.fhi.no/en/ch/studies/moba/for-forskere-artikler/questionnaires-from-moba/.

Correspondence

Viktoria Birkenæs, Division of Mental Health and Addiction, Centre for Precision Psychiatry, Oslo University Hospital, Ullevål, Kirkeveien 166, Building 49, 0450 Oslo, Norway; Email: viktoria.birkenas@medisin.uio.no

Key points

What's known

- Adolescents report more experiences than adults but societal shifts like the digital revolution and COVID-19 pandemic may make current self-report questionnaires less accurate.

What's new

- In this large population-based study of adolescent psychotic experiences, the CAPE-16 shows high reliability and consistent response patterns across sex and pandemic periods.
- More adolescent psychotic experiences correlate with a higher future risk of psychiatric illness.
- A comparison of responses between adolescents and their fathers revealed that adolescents interpret items related to digital technology differently.

What's relevant

- These findings are timely given increasing youth mental health issues, especially in the context of digitalization and the aftermath of the COVID-19 pandemic.

References

Aloba, O., & Opakunle, T. (2020). The Brief 10-Item Community Assessment of Psychic Experiences-Positive Scale (Brief CAPE-P10): Initial psychometric properties, gender measurement invariance and mean differences among Nigerian adolescents. *Early Intervention in Psychiatry*, *14*, 723–733.

Andrews, G., & Peters, L. (1998). The psychometric properties of the Composite International Diagnostic Interview. *Social Psychiatry and Psychiatric Epidemiology*, *33*, 80–88.

Barbosa, M.G., Machado, V., Ziebold, C., Moriyama, T., Bressan, R.A., Pan, P., … & Gadelha, A. (2023). Longitudinal invariance of psychotic experiences in children and adolescents: What do the data tell us? *Schizophrenia Research*, *255*, 33–40.

Benjamini, Y., & Hochberg, Y. (1995). Controlling the false discovery rate: A practical and powerful approach to multiple testing. *Journal of the Royal Statistical Society. Series B, Statistical Methodology*, *57*, 289–300.

Bentall, R.P., Fernyhough, C., Morrison, A.P., Lewis, S., & Corcoran, R. (2007). Prospects for a cognitive-developmental account of psychotic experiences. *British Journal of Clinical Psychology*, *46*, 155–173.

Biele, G., Gustavson, K., Czajkowski, N.O., Nilsen, R.M., Reichborn-Kjennerud, T., Magnus, P.M., … & Aase, H. (2019). Bias from self selection and loss to follow-up in prospective cohort studies. *European Journal of Epidemiology*, *34*, 927–938.

Birkenæs, V., Refsum Bakken, N., Frei, E., Jaholkowski, P., Smeland, O.B., Tesfaye, M., … & Elken Sønderby, I. (2023). Psychometric properties and diagnostic associations of the short-form community assessment of psychic experiences in a population-based sample of 29 021 adult men. *Schizophrenia Bulletin*, *49*, 1229–1238.

Campbell, O.L.K., Bann, D., & Patalay, P. (2021). The gender gap in adolescent mental health: A cross-national investigation of 566,829 adolescents across 73 countries. *SSM – Population Health*, *13*, 100742.

Capra, C., Kavanagh, D.J., Hides, L., & Scott, J.G. (2017). Current CAPE-15: A measure of recent psychotic-like experiences and associated distress. *Early Intervention in Psychiatry*, *11*, 411–417.

Chandra, A., & Minkovitz, C.S. (2006). Stigma starts early: Gender differences in teen willingness to use mental health services. *Journal of Adolescent Health*, *38*, 754.e1–754.e8.

Chen, F.F. (2008). What happens if we compare chopsticks with forks? The impact of making inappropriate comparisons in cross-cultural research. *Journal of Personality and Social Psychology*, *95*, 1005–1018.

Deluca, J.S. (2020). Conceptualizing adolescent mental illness stigma: Youth stigma development and stigma reduction programs. *Adolescent Research Review*, *5*, 153–171.

DeVylder, J., Yamaguchi, S., Hosozawa, M., Yamasaki, S., Ando, S., Miyashita, M., … & Nishida, A. (2024). Adolescent psychotic experiences before and during the COVID-19 pandemic: A prospective cohort study. *Journal of Child Psychology and Psychiatry*, *65*, 776–784.

Dingli, A., & Seychell, D. (2015). *The new digital natives*. Stuttgart, Germany: JB Metzler. https://doi.org/10.1007/978-3-662-46590-5

Evensen, M., Hart, R.K., Godøy, A.A., Hauge, L.J., Lund, I.O., Knudsen, A.K.S., … & Reneflot, A. (2023). Impact of the COVID-19 pandemic on mental healthcare consultations among children and adolescents in Norway: A nationwide registry study. *European Child and Adolescent Psychiatry*, *32*, 1025–1035.

Fekih-Romdhane, F., Sassi, H., & Cheour, M. (2021). The relationship between social media addiction and psychotic-like experiences in a large nonclinical student sample. *Psychosis*, *13*(4), 349–360.

Fekih-Romdhane, F., Farah, N., Malaeb, D., Cheour, M., Obeid, S., & Hallit, S. (2024). Validation of the Arabic version of the community assessment of psychic experiences (CAPE-42) in a large sample of young adults from the general population. *International Journal of Mental Health and Addiction*, *22*(5), 2649–2666.

Fisher, H.L., Caspi, A., Poulton, R., Meier, M.H., Houts, R., Harrington, H., … & Moffitt, T.E. (2013). Specificity of childhood psychotic symptoms for predicting schizophrenia by 38 years of age: A birth cohort study. *Psychological Medicine*, *43*, 2077–2086.

Fusar-Poli, P., Tantardini, M., De Simone, S., Ramella-Cravaro, V., Oliver, D., Kingdon, J., … & McGuire, P. (2017). Deconstructing vulnerability for psychosis: Meta-analysis of environmental risk factors for psychosis in subjects at ultra high-risk. *European Psychiatry*, *40*, 65–75.

Hanssen, M., Krabbendam, L., Vollema, M., Delespaul, P., & Van Os, J. (2006). Evidence for instrument and family-specific variation of subclinical psychosis dimensions in the general population. *Journal of Abnormal Psychology*, *115*, 5–14.

Healy, C., Brannigan, R., Dooley, N., Coughlan, H., Clarke, M., Kelleher, I., & Cannon, M. (2019). Childhood and adolescent psychotic experiences and risk of mental disorder: A systematic review and meta-analysis. *Psychological Medicine*, *49*, 1589–1599.

Immonen, J., Jääskeläinen, E., Korpela, H., & Miettunen, J. (2017). Age at onset and the outcomes of schizophrenia: A systematic review and meta-analysis. *Early Intervention in Psychiatry*, *11*, 453–460.

Johns, L.C., & Van Os, J. (2001). The continuity of psychotic experiences in the general population. *Clinical Psychology Review*, *21*(8), 1125–1141. https://doi.org/10.1016/S0272-7358(01)00103-9

Kelleher, I., Connor, D., Clarke, M.C., Devlin, N., Harley, M., & Cannon, M. (2012). Prevalence of psychotic symptoms in

childhood and adolescence: A systematic review and meta-analysis of population-based studies. *Psychological Medicine*, *42*, 1857–1863.
Keyes, K.M., Gary, D., O'Malley, P.M., Hamilton, A., & Schulenberg, J. (2019). Recent increases in depressive symptoms among US adolescents: Trends from 1991 to 2018. *Social Psychiatry and Psychiatric Epidemiology*, *54*, 987–996.
Lindgren, M., Numminen, L., Holm, M., Therman, S., & Tuulio-Henriksson, A. (2022). Psychotic-like experiences of young adults in the general population predict mental disorders. *Psychiatry Research*, *312*, 114543.
Linscott, R.J., & Van Os, J. (2013). An updated and conservative systematic review and meta-analysis of epidemiological evidence on psychotic experiences in children and adults: On the pathway from proneness to persistence to dimensional expression across mental disorders. *Psychological Medicine*, *43*, 1133–1149.
Madigan, S., Racine, N., Vaillancourt, T., Korczak, D.J., Hewitt, J.M.A., Pador, P., … & Neville, R.D. (2023). Changes in depression and anxiety among children and adolescents from before to during the COVID-19 pandemic: A systematic review and meta-analysis. *JAMA Pediatrics*, *177*, 567–581.
Magnus, P., Birke, C., Vejrup, K., Haugan, A., Alsaker, E., Daltveit, A.K., … & Stoltenberg, C. (2016). Cohort profile update: The Norwegian Mother and Child Cohort Study (MoBa). *International Journal of Epidemiology*, *45*, 382–388.
Magnus, P., Irgens, L.M., Haug, K., Nystad, W., Skjærven, R., Stoltenberg, C., … & Wiik, J. (2006). Cohort profile: The Norwegian Mother and Child Cohort Study (MoBa). *International Journal of Epidemiology*, *35*, 1146–1150.
Mark, W., & Toulopoulou, T. (2016). Psychometric properties of "community assessment of psychic experiences": Review and meta-analyses. *Schizophrenia Bulletin*, *42*, 34–44.
Martin, J., Tilling, K., Hubbard, L., Stergiakouli, E., Thapar, A., Davey Smith, G., … & Zammit, S. (2016). Association of genetic risk for schizophrenia with nonparticipation over time in a population-based cohort study. *American Journal of Epidemiology*, *183*, 1149–1158.
McDonald, R.P. (2013). *Test theory: A unified treatment*. New York, NY: Psychology Press. https://doi.org/10.4324/9781410601087
McGrath, J.J., Saha, S., Al-Hamzawi, A., Alonso, J., Bromet, E.J., Bruffaerts, R., … & Kessler, R.C. (2015). Psychotic experiences in the general population: A cross-national analysis based on 31 261 respondents from 18 countries. *JAMA Psychiatry*, *72*, 697–705.
McGrath, J.J., Saha, S., Al-Hamzawi, A., Andrade, L., Benjet, C., Bromet, E.J., … & Kessler, R.C. (2016). The bidirectional associations between psychotic experiences and DSM-IV mental disorders. *American Journal of Psychiatry*, *173*, 997–1006.
McNeish, D. (2018). Thanks coefficient alpha, We'll take it from here. *Psychological Methods*, *23*, 412–433.
Naicker, S.N., Norris, S.A., & Richter, L.M. (2021). Secondary analysis of retrospective and prospective reports of adverse childhood experiences and mental health in young adulthood: Filtered through recent stressors. *EClinicalMedicine*, *40*, 101094.
Niarchou, M., Zammit, S., & Lewis, G. (2015). The Avon longitudinal study of parents and children (ALSPAC) birth cohort as a resource for studying psychopathology in childhood and adolescence: A summary of findings for depression and psychosis. *Social Psychiatry and Psychiatric Epidemiology*, *50*, 1017–1027.
Oh, H., Schiffman, J., Marsh, J., Zhou, S., Koyanagi, A., & DeVylder, J. (2021). COVID-19 infection and psychotic experiences: Findings from the healthy minds study 2020. *Biological Psychiatry Global Open Science*, *1*, 310–316.
Putnick, D.L., & Bornstein, M.H. (2016). Measurement invariance conventions and reporting: The state of the art and future directions for psychological research. *Developmental Review*, *41*, 71–90.
R Core Team. (2020). *R: A language and environment for statistical computing*. Vienna, Austria: R Foundation for Statistical Computing. Available from: https://www.R-project.org/. (n.d.).
Rimvall, M.K., Simonsen, E., Zhang, J., Andersen, Z.J., Hastrup, L.H., Jeppesen, P., … & Koch, S.V. (2024). Examining psychotic experiences in two generations - findings from a rural household-based cohort study; the Lolland-Falster health study. *Psychological Medicine*, *54*, 1382–1390.
Salazar De Pablo, G., Aymerich, C., Guinart, D., Catalan, A., Alameda, L., Trotta, G., … & Correll, C.U. (2024). What is the duration of untreated psychosis worldwide? – A meta-analysis of pooled mean and median time and regional trends and other correlates across 369 studies. *Psychological Medicine*, *54*(4), 652–662. https://doi.org/10.1017/S0033291723003458
Sieradzka, D., Power, R.A., Freeman, D., Cardno, A.G., McGuire, P., Plomin, R., … & Ronald, A. (2014). Are genetic risk factors for psychosis also associated with dimension-specific psychotic experiences in adolescence? *PLoS One*, *9*, e94398.
Skrobinska, L., Newman-Taylor, K., & Carnelley, K. (2024). Psychosis and help-seeking behaviour–a systematic review of the literature. *Psychology and Psychotherapy: Theory, Research and Practice*, *97*, 583–605.
Stefanis, N.C., Hanssen, M., Smirnis, N.K., Avramopoulos, D.A., Evdokimidis, I.K., Stefanis, C.N., … & Van Os, J. (2002). Evidence that three dimensions of psychosis have a distribution in the general population. *Psychological Medicine*, *32*, 347–358.
Sullivan, S.A., Kounali, D., Cannon, M., David, A.S., Fletcher, P.C., Holmans, P., … & Zammit, S. (2020). A population-based cohort study examining the incidence and impact of psychotic experiences from childhood to adulthood, and prediction of psychotic disorder. *American Journal of Psychiatry*, *177*, 308–317.
Sun, M., Wang, D., Jing, L., Xi, C., Dai, L., & Zhou, L. (2020). Psychometric properties of the 15-item positive subscale of the community assessment of psychic experiences. *Schizophrenia Research*, *222*, 160–166.
Tambs, K., & Moum, T. (1993). How well can a few questionnaire items indicate anxiety and depression? *Acta Psychiatrica Scandinavica*, *87*, 364–367.
Tambs, K., & Røysamb, E. (2014). Selection of questions to short-form versions of original psychometric instruments in MoBa. *Norsk Epidemiologi*, *24*, 195–201.
Van Den Bergh, O., & Walentynowicz, M. (2016). Accuracy and bias in retrospective symptom reporting. *Current Opinion in Psychiatry*, *29*, 302–308.
Van Der Steen, Y., Myin-Germeys, I., Van Nierop, M., Ten Have, M., De Graaf, R., Van Dorsselaer, S., … & Van Winkel, R. (2019). "False-positive" self-reported psychotic experiences in the general population: An investigation of outcome, predictive factors and clinical relevance. *Epidemiology and Psychiatric Sciences*, *28*, 532–543.
Van Volkom, M., Stapley, J.C., & Malter, J. (2013). Use and perception of technology: Sex and generational differences in a community sample. *Educational Gerontology*, *39*, 729–740.
Vejrup, K., Magnus, P., & Magnus, M. (2022). Lost to follow-up in the Norwegian mother, father and child cohort study. *Paediatric and Perinatal Epidemiology*, *36*, 300–309.
Wang, D., Zhou, L., Chen, C., & Sun, M. (2023). Psychotic-like experiences during COVID-19 lockdown among adolescents: Prevalence, risk and protective factors. *Schizophrenia Research*, *252*, 309–316.
Wilson, R.S., Yung, A.R., & Morrison, A.P. (2020). Comorbidity rates of depression and anxiety in first episode psychosis: A

systematic review and meta-analysis. *Schizophrenia Research*, *216*, 322–329.
World Health Organization (Ed.). (2004). *ICD-10: international statistical classification of diseases and related health problems: tenth revision* (2nd edn). World Health Organization. https://iris.who.int/handle/10665/42980
Yoon, M., & Lai, M.H.C. (2018). Testing factorial invariance with unbalanced samples. *Structural Equation Modeling*, *25*, 201–213.
Yuan, K.H., & Bentler, P.M. (1998). Structural equation modeling with robust covariances. *Sociological Methodology*, *28*(1), 363–396. https://doi.org/10.1111/0081-1750.00052
Zammit, S., Hamshere, M., Dwyer, S., Georgiva, L., Timpson, N., Moskvina, V., … & O'Donovan, M.C. (2014). A population-based study of genetic variation and psychotic experiences in adolescents. *Schizophrenia Bulletin*, *40*, 1254–1262.
Zammit, S., Kounali, D., Cannon, M., David, A.S., Gunnell, D., Heron, J., … & Lewis, G. (2013). Psychotic experiences and psychotic disorders at age 18 in relation to psychotic experiences at age 12 in a longitudinal population-based cohort study. *American Journal of Psychiatry*, *170*, 742–750.

Accepted for publication: 12 May 2025