Schizophrenia Research 231 (2021) xxx

Contents lists available at ScienceDirect

Schizophrenia Research

journal homepage: www.elsevier.com/locate/schres

Internalizing and externalizing problems across childhood and psychotic-like experiences in young-adulthood: The role of developmental period

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ARTICLE INFO

Article history:
Received 13 August 2020
Received in revised form 23 March 2021
Accepted 28 March 2021
Available online xxxx

Keywords:
ALSPAC
Psychotic-like experiences
Internalizing
Externalizing
Developmental
Childhood

ABSTRACT

Background: Psychopathology in childhood and adolescence, commonly indexed by co-occurring internalizing and externalizing problem behaviors, has been found to predict psychotic-like experiences (PLEs) in adults. However, studies to date have rarely examined internalizing and externalizing problem behaviors simultaneously or identified in which developmental period do these problem behaviors predict PLEs in adults. This study tests to what extent internalizing and externalizing problem behaviors in childhood (4–9 years) or adolescence (11–16 years) predict PLEs in young-adulthood (18 years).

Methods: Parent-rated child internalizing and externalizing problems on the Strengths and Difficulties Questionnaire at ages 4, 6, 8, 9, 11, 13, and 16 years from the Avon Longitudinal Study of Parents and Children ($N = 4717$) were modelled using two-piece latent growth curve modelling to predict clinician-rated PLEs at age 18 years, controlling for confounders (gender, ethnicity, socio-economic status, parental education and stressful life events) assessed prior to baseline at age 4 years.

Results: Controlling for confounders, an increase in childhood internalizing problems from 4 to 9 years and externalizing problems at baseline (at 4 years) predicted PLEs at 18 years, explaining 9.5% of the variance in adult PLEs. These associations were independent to controls for any changes in adolescent internalizing and externalizing problems from 11 to 16 years.

Conclusions: High baseline levels of externalizing problems and increasing internalizing problems throughout childhood can predict PLEs at 18 years. Externalizing problems around the transition to primary school and internalizing problems throughout childhood may be particularly helpful in informing risk of PLEs in young-adulthood.

1. Introduction

Psychotic symptoms exist in adult patients, young adults, and community youths at varying degrees of severity (Bebbington et al., 2013; Bird et al., 2017; Wong et al., 2014). A systematic review of 19 general population studies showed that younger children (9–12 years) generally report higher prevalence rates of psychotic-like experiences (PLEs) than older children (13–18 years), at 17% and 7.5%, respectively (Kelleher et al., 2012). More recent cross-sectional studies of school children have either replicated this age contrast - reporting higher prevalence rates in childhood at 8 to 10 years and a leveling off in adolescence, at 11 to 14 years (Wong et al., 2014) - or reported no age contrast in the same age range (Zhou et al., 2018). Why more PLEs may be reported in childhood than in adolescence may be explained by three reasons: First, it may be due to the still developing subcortical regions of children's brains. For example, research on children's ability to read others' minds – or theory of mind – suggests that social cognition is still developing beyond the preschool years, with theory of mind shown to increase across 7 to 13 years over and above verbal ability (Devine and Hughes, 2013). This would suggest that, compared to adolescents, children may have more limited cognitive abilities to make sense of their social interactions with others (e.g., they may be more affected by negative peer experiences because they lack the reasoning skills to understand others' minds) and have less control over their own behaviors (e.g., they show poorer emotional regulation). Second, children may misunderstand questions on PLEs, often endorsing more symptoms compared to interviewer assessed PLEs as demonstrated by low informant agreement ($\kappa = 0.46$) (Wong, 2015). Third, there is some evidence to suggest that the turning point observed in PLEs at age 11 years may reflect changes in the school environment as children transition from primary to secondary school (Wong et al., 2014; Wong and Raine, 2018).

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https://doi.org/10.1016/j.schres.2021.03.016

Please cite this article as: K.K.-Y. Wong, M. Francesconi and E. Flouri, Internalizing and externalizing problems across childhood and psychotic-like experiences in young-ad..., Schizophrenia Research, https://doi.org/10.1016/j.schres.2021.03.016

Although PLEs may be difficult to assess properly in early development, they have been found to co-occur with childhood psychopathology (Lancefield et al., 2016), commonly indexed by internalizing problem behaviors like anxiety and externalizing problem behaviors like hyperactivity and conduct problems. While limited research has explored the early childhood psychopathology/later PLEs relationship, the prospective and cross-sectional studies that do exist have found internalizing and externalizing problems in both younger children and adolescents in the community to predict later PLEs (Bird et al., 2017; Gin et al., 2020; Liu et al., 2019; Wong et al., 2014; Wong and Raine, 2019; Wong et al., 2018). However, whether it is internalizing and externalizing problems in childhood or adolescence or *both* that may be related to later PLEs and whether any relationships found are not confounded have yet to be addressed. This is, respectively, due to the narrow assessment points in most studies and the lack of control for other risk factors associated with both internalizing/externalizing problems and PLEs including: *social risks* (i.e., childhood trauma (Kelleher et al., 2008), urbanicity and disadvantaged homes (Polanczyk et al., 2010)), *biological risks* (family history of psychosis (Zammit et al., 2008)), *inflammation* (Francesconi et al., 2019), and *cognitive impairments* (poorer motor skills and lower intelligence (Cannon et al., 2002; Horwood et al., 2008)).

There are another two limitations in the extant literature. First, the available evidence suggests that internalizing problems, especially anxiety, are more strongly associated with PLEs, like paranoia, than are externalizing problems like aggression and callous-unemotional traits (Wong et al., 2014). However, with few exceptions (Francesconi et al., 2019; Gjone and Stevenson, 1997), most studies assess internalizing or externalizing problems in separate models without accounting for the high comorbidity between them (Lancefield et al., 2016) or for the fluctuation of these problems throughout different developmental periods. Given that externalizing problems tend to be more observable in childhood and internalizing problems in adolescence (Bongers et al., 2004; Wolff and Ollendick, 2006), it may also be suggested that *levels* and *changes* in levels of these problems within developmental stage may independently predict PLEs in young-adulthood. Second, the few available longitudinal studies have typically aggregated change across a few narrow assessment timepoints and modelled data assuming stable linear trajectories of problems. Even the one study, to our knowledge, modelling risk of PLEs by symptom trajectory group over time (e.g., high, low, remitting, persisting, desisting) could not, given its analytic approach, identify the developmental period most predictive of later PLEs (Polanczyk et al., 2010).

Consequently, it is unclear if *levels* and *changes* in internalizing and externalizing problems during different early developmental periods – like childhood and adolescence – may predict psychosis risk in adult life. Knowing however whether childhood and/or adolescent internalizing and/or externalizing problems predict PLEs may be important for informing early preventive interventions for psychosis with greater precision. Our study, aiming to add this knowledge, reports findings from the Avon Longitudinal Study of Parents and Children (ALSPAC) testing the hypothesis that both internalizing and externalizing problem behaviors across ages 4 to 16 years will be positively associated with levels of PLEs at age 18 years, controlling for covariates such as child's gender, paternal socioeconomic status, maternal education and stressful life experiences. To test our hypothesis, we apply a flexible modelling technique, two-piece growth modelling (2-PGM) to understand which developmental period (childhood and/or adolescence) of internalizing and externalizing problems, jointly modelled, predicts PLEs in young-adulthood. 2-PGM estimates change across time while controlling for confounders, allowing us to test the specific influences (levels/changes in symptoms) of a-priori development periods that may predict PLEs, a feature that is not available in growth curve modelling or growth mixture modelling which estimate growth trajectories over an entire developmental period. This technique therefore should be particularly useful in capturing the progression of internalizing and externalizing problems behaviors that are known to fluctuate throughout distinct stages of development (Lee and Bukowski, 2012) and be highly comorbid (Lilienfeld, 2003; Willner et al., 2016).

2. Method

2.1. Participants

Ethical approval of the ALSPAC cohort was obtained from the ALSPAC Ethics and Law Committee and the Local Research Ethics Committees (Boyd et al., 2013). Informed consent for the use of data collected via questionnaires and clinics was obtained from participants following the recommendations of the ALSPAC Ethics and Law Committee at the time (details at www.alspac.bris.ac.uk). In all, 14,541 pregnant women living in Bristol, UK, and surrounding areas, were enrolled for the study (details of all the data that is available at http://www.bristol.ac.uk/alspac/researchers/our-data/). Children were invited to attend annual assessment clinics, including face-to-face interviews and psychological and physical tests from age 7 years onward (Fraser et al., 2012; Northstone et al., 2019). Additional children were recruited using the original enrolment definition from the participating children's age 7 years onwards, allowing us to have available study data for 15,445 fetuses. Of those, 14,684 were alive at 1 year of age. In an attempt to bolster the initial sample size, new pregnancies have been enrolled since then resulting in additional children being enrolled as well. To date, the total sample size for analyses using any data collected after the age of 7 years is 15,454 pregnancies, resulting in 15,589 fetuses. Of these 14,901 were alive at 1 year of age. In this study our analytic sample was those with full data on PLEs at 18 years ($n = 4717$). Missing data on all other study variables are found in Table 1.

2.2. Measures

2.2.1. Internalizing and externalizing problem behaviors at ages 4, 6, 8, 9, 11, 13, and 16 years

Internalizing and externalizing problems were assessed via the mother-reported 25-item Strengths and Difficulties Questionnaire (SDQ) (Goodman, 1997). The SDQ is a valid and reliable tool for measuring emotional and behavioral difficulties in children (Goodman, 2001). Excluding the 5 prosocial items, 20 items on children's difficulties (in the past 6 months) were summed to create a 10-item *internalizing* (emotional problems and peer relationship problems) problems scale and a 10-item *externalizing* (conduct problems and hyperactivity-inattention) problems scale (Goodman et al., 2010). The sum of the two scales gives a total difficulties score. The items are scored on a 3-point scale with 0 = 'not true', 1 = 'somewhat true' and 2 = 'certainly true'. These subscales demonstrated good internal reliability at all ages we considered.

2.2.2. Psychotic-like experiences (PLEs) at age 18 years

Problems of psychosis were assessed through the clinician-administered 12-item semi-structured Psychosis-Like Symptom Interview (PLIKSi) (Zammit et al., 2013). The PLIKSi is a widely used assessment of the presence of delusions and hallucinations through 7 items from the Diagnostic Interview Schedule for Children Version IV (Shaffer et al., 2000) and 5 items from the Schedules for Clinical Assessment in Neuropsychiatry version 2 (WHO, 1994). Psychotic experiences were coded as not present, suspected, or definitely psychotic. For suspected or definite psychotic experiences, interviewers also reported the frequency; impact on affect, impact on social function, impact on educational/occupational function; help seeking from professionals; and attributions, such as fever, hypnopompic/hypnogogic state, or substance use. In our analysis, we defined individuals with psychotic-like experiences at age 18 years as those with definite psychotic experiences compared with everyone else.

Table 1
Means, standard deviations, and sample sizes for all study variables.

Descriptive statistics		
Analytic sample ($n = 4717$)	*N*	*M* (*SD*)
Continuous variables		
Internalizing, 4 years	3895	2.88 (2.35)
Internalizing, 6 years	3767	2.53 (2.50)
Internalizing, 8 years	3728	2.95 (2.74)
Internalizing, 9 years	3897	2.59 (2.68)
Internalizing, 11 years	3809	2.51 (2.69)
Internalizing, 13 years	3744	2.58 (2.73)
Internalizing, 16 years	3451	2.54 (2.72)
Externalizing, 4 years	3884	5.59 (3.14)
Externalizing, 6 years	3757	4.67 (3.15)
Externalizing, 8 years	3726	4.51 (3.30)
Externalizing, 9 years	3893	3.90 (3.01)
Externalizing, 11 years	3804	3.66 (2.90)
Externalizing, 13 years	3739	3.87 (3.01)
Externalizing, 16 years	3458	3.35 (2.88)
Stressful life events score		
Total score, summed 18 m, 30 m, 42 m	3761	4.00 (2.48)
Categorical variables		
Paternal social class (I to V)		
I (non-manual)	577	12.23%
II (non-manual)	1484	31.46%
III (non-manual)	481	10.20%
III (manual)	1018	21.58%
IV (manual)	311	6.59%
V (manual)	86	1.82%
Missing	760	16.11%
Maternal education		
Below O-level	667	14.14%
O-level	1463	31.02%
A-level	1193	25.29%
University degree	826	17.51%
Missing	568	12.04%
Ethnicity		
White	4045	85.75%
Non-white	179	3.79%
Missing	493	10.45%
Gender		
Male	2051	43.48%
Female	2665	56.50%
Missing	1	0.02%
Psychotic-like experiences, 18 years		
Definite	229	4.85%
None definite	4488	95.15%

2.2.3. Covariates

We adjusted our models for a number of baseline (up to about age 4 years, when SDQ was first measured in our sample) covariates known to be associated with children's internalizing and externalizing problems but also with PLEs. These included gender, ethnicity (white, non-white), parental socioeconomic status (approximated by maternal education (below O-level, O-level only, A-level only, university degree) and paternal social class (I, II, III (non-manual), III (manual), IV, V)), and child's stressful life events until age 4 years. In our study these were measured using a 14-item upsetting events checklist (Barnett et al., 1983; Brown et al., 1973a; Brown et al., 1973b; Honnor et al., 1994), completed by the mother for the child, at the following timepoints in ALSPAC: 18 months (covering events since the child was 6 months), 30 months (events since the child was 18 months), and 42 months (since the child was 30 months). We derived a life events total score for the period of 6 months to 42 months which was the sum of the item scores at all these timepoints (see Online Supplementary materials Table 2).

2.3. Data analysis

A latent growth modelling (LGM) and two-piece growth modelling (2-PGM) were conducted using *MPlus* 7.4 for Mac (Muthén and Muthén, 1998-2015) to test how a single trajectory over childhood and adolescence compared against different trajectories across the two stages: childhood (4–9 years) and adolescence (11–16 years). Applying 2-PGM to our data allows the calculation of a latent variable for the baseline (intercept) level of psychopathology and separate growth time scores to estimate if changes in psychopathology across theoretically-identified transition periods, such as *childhood* (slope 1) and *adolescence* (slope 2), may predict PLEs at age 18 years. Therefore, our 2-PGM produces three latent variables (intercept, slope 1, slope 2) with associated means and variances that can be used to predict our outcome, PLEs in young-adulthood at 18 years. In our data, the *intercept* represents the baseline level of internalizing or externalizing problems at age 4 years. *Slope 1* represents the average rate of change in internalizing/externalizing problems over time and individual variability about that change in childhood (4–9 years). Likewise, *slope 2* represents the change in adolescence (11–16 years). Weighted least square mean and variance adjusted (WLSMV) estimators were requested as the dependent variable was categorical.

First, LGMs were fitted to examine the role of the average trajectories of combined internalizing and externalizing problems (total difficulties score) across 4 to 16 years in predicting PLEs at 18 years. Second, parallel 2-PGMs were developed to examine the differential developmental effects of childhood and adolescent internalizing and externalizing psychopathology on PLEs at age 18 years. Third and finally, the same models were rerun controlling for potential confounders. Five goodness-of-fit indices were used for model comparison: chi-square statistic (χ^2), root mean squared error of approximation (RMSEA), comparative fit index (CFI), Tucker-Lewis index (TLI), BIC and the AIC (Akaike, 1974) calculated by $\chi^2 - 2^*$(degrees of freedom). High CFI (>0.90), high TLI (>0.90), low RMSEA (<0.06) and the lowest AIC among nested model comparisons indicate a good-fitting model (Brown and Cudeck, 1993; Hu and Bentler, 1999).

2.4. Missing data

We ran our models on complete data available on the PLIKSi at 18 years and used full information maximum likelihood (FIML) estimation (Enders, 2010) to include those with data on at least one confounder variable. FIML makes the assumption that data are missing-at-random (i.e., given the observed data included in the model, the missingness mechanism does not depend on the unobserved data). Missing data for study variables is detailed in Table 1.

3. Results

3.1. Descriptive analyses

Table 1 shows the means, standard deviations, and sample sizes (where appropriate) for all study variables. Online Supplementary Table 1 presents the intercorrelations between all study variables. Internalizing and externalizing problems across all timepoints (4 to 16 years) were generally positively associated with PLEs at age 18 years, as were being female, low maternal education and low paternal socioeconomic status.

Preliminary analysis testing an LGM with the total difficulties score was conducted to explore the average trajectory of combined internalizing and externalizing problems. This demonstrated a poor fitting model (CFI/TLI = 0.858/858, $\chi^2(28) = 1513.702$, $p < .001$, RMSEA = 0.106, *90%CI* [0.102–0.111], WRMR = 4.532, $N = 4717$, see Online Supplementary Fig. 1). From here onwards, and in line with our hypothesis for the importance of considering different trajectories for internalizing and externalizing problems, we estimate the trajectories of internalizing and externalizing problems in parallel.

Table 2
Model fit indices for linear and piecewise growth curve models of internalizing and externalizing problem behaviors.

Model	Free	AIC (χ^2-2df)	χ^2 (df)	RMSEA [95%CI]	CFI/TLI	WRMR
Model 1. Int/Ext Linear Parallel Growth Curve Model	33	2292.341	2494.341 (101)***	0.071 [0.068–0.073]	0.873/0.868	3.966
Model 2. Int/Ext Parallel 2-Piece Growth Curve Model	53	486.277	648.277 (81)***	0.039 [0.036–0.041]	0.970/0.961	1.727
Model 3. Int/Ext Linear Parallel Growth Curve Model with covariates	78	3022.016	2879.301 (151)***	0.062 [0.060–0.064]	0.882/0.852	3.084
Model 4. Int/Ext Parallel 2-Piece Growth Curve Model with covariates	108	518.236	760.236 (121)***	0.033 [0.031–0.036]	0.972/0.957	1.374

Notes. Dependent variable = PLEs at age 18 years. $N = 4717$. Estimator = WLSMV, Iterations = 10,000, Coverage = 0.05.
*** $p < .000$

3.2. LGM of parallel internalizing and externalizing problem behaviors predicting PLEs at age 18 years

The LGM of internalizing and externalizing problems measured at 4 to 16 years which assumes a uniform rate of change relative to age (as we specified a linear slope for the whole period) predicting PLEs at age 18 years demonstrated a mediocre fit to the data (see Model 1, Table 2). Above and beyond concurrent externalizing problem behaviors assessed at each timepoint, this model showed that baseline (age 4 years) externalizing problems ($b = 0.111$, $SE = 0.047$, $p = .019$) and changes in internalizing problems across childhood and adolescence (ages 4–16 years) ($b = 0.207$, $SE = 0.051$, $p < .001$) predicted PLEs at 18 years, but baseline internalizing ($p = .095$) or changes in externalizing problem behaviors ($p = .074$) did not (see Online Supplementary Fig. 2). This model explained 6.4% of the variance in PLEs at age 18 years.

3.3. 2-PGM of childhood (4–9 years) and adolescent (11–16 years) internalizing and externalizing problem behaviors predicting PLEs at age 18 years

The 2-PGM of internalizing and externalizing problems during childhood and adolescence predicting PLEs at age 18 years demonstrated a good fit to the data (see Model 2, Table 2). Above and beyond concurrent problem behaviors across development, baseline externalizing problems ($b = 0.137$, $SE = 0.066$, $p = .037$) and changes in *childhood* internalizing problems ($b = 0.223$, $SE = 0.059$, $p = .001$) predicted PLEs at 18 years (Fig. 1). Baseline internalizing problems ($p = .311$), slope of *adolescent* internalizing problems ($p = .099$), slope of *childhood* externalizing problems ($p = .111$), and slope of *adolescent* externalizing problems ($p = .329$) did not predict PLEs at 18 years. This model explained 7.1% of the variance in PLEs at age 18 years.

3.4. LGM and 2-PGM controlling for covariates assessed prior to baseline (age 4 years)

Rerunning the same models controlling for covariates assessed before age 4 years produced a poor model fit for the LGM (see Model 3 in Table 2) with none of the latent variables predicting PLEs at 18 years (all $ps > .05$). On the other hand, rerunning the 2-PGM controlling for covariates improved the model fit to the data (see Model 4, Table 2), with the slope of childhood internalizing problems ($b = 0.207$, $SE = 0.059$, $p < .001$) and baseline externalizing problems ($b = 0.139$, $SE = 0.068$, $p = .040$) predicting PLEs at 18 years, as in the unadjusted model. Baseline internalizing problems ($p = .376$), slope of adolescent internalizing problems ($p = .133$), slope of childhood externalizing problems ($p = .080$),

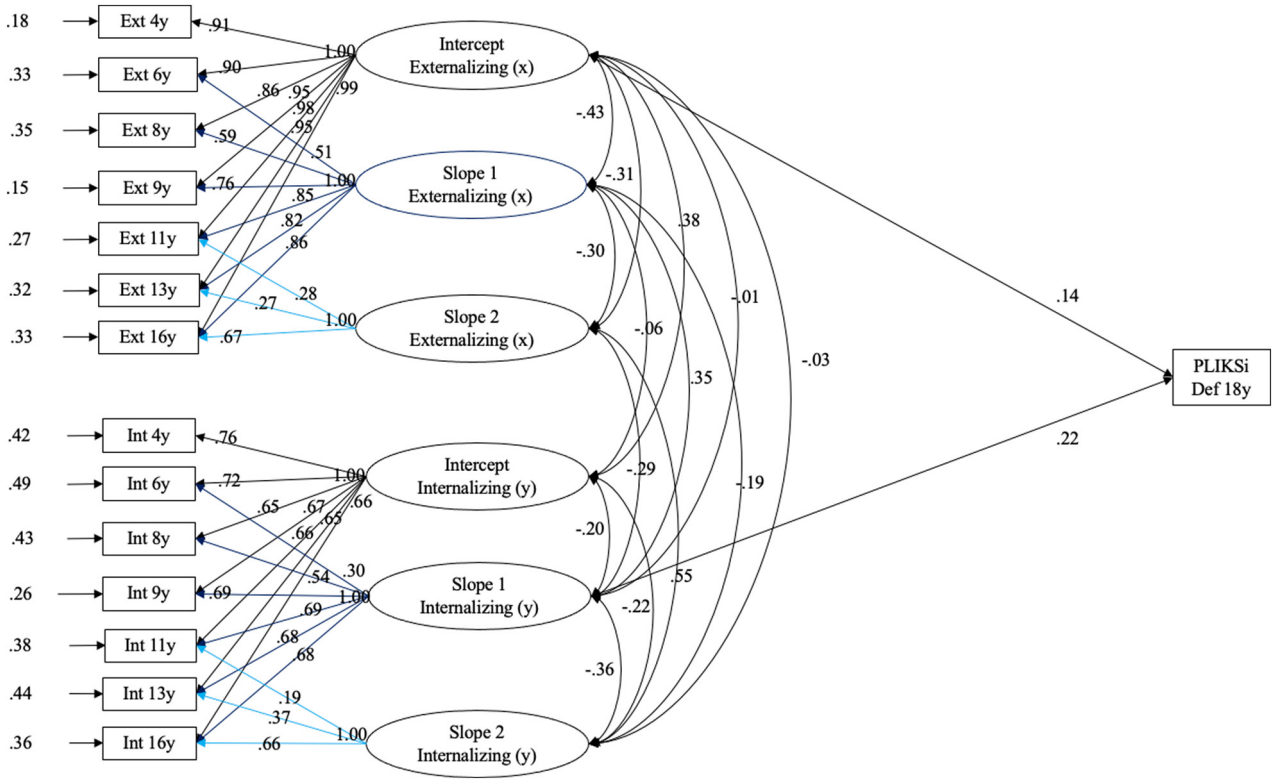

Fig. 1. Two-piece latent growth curve model (2-PGM) (unadjusted) of parallel externalizing and internalizing problem behaviors predicting PLEs at 18 years (standardized beta).

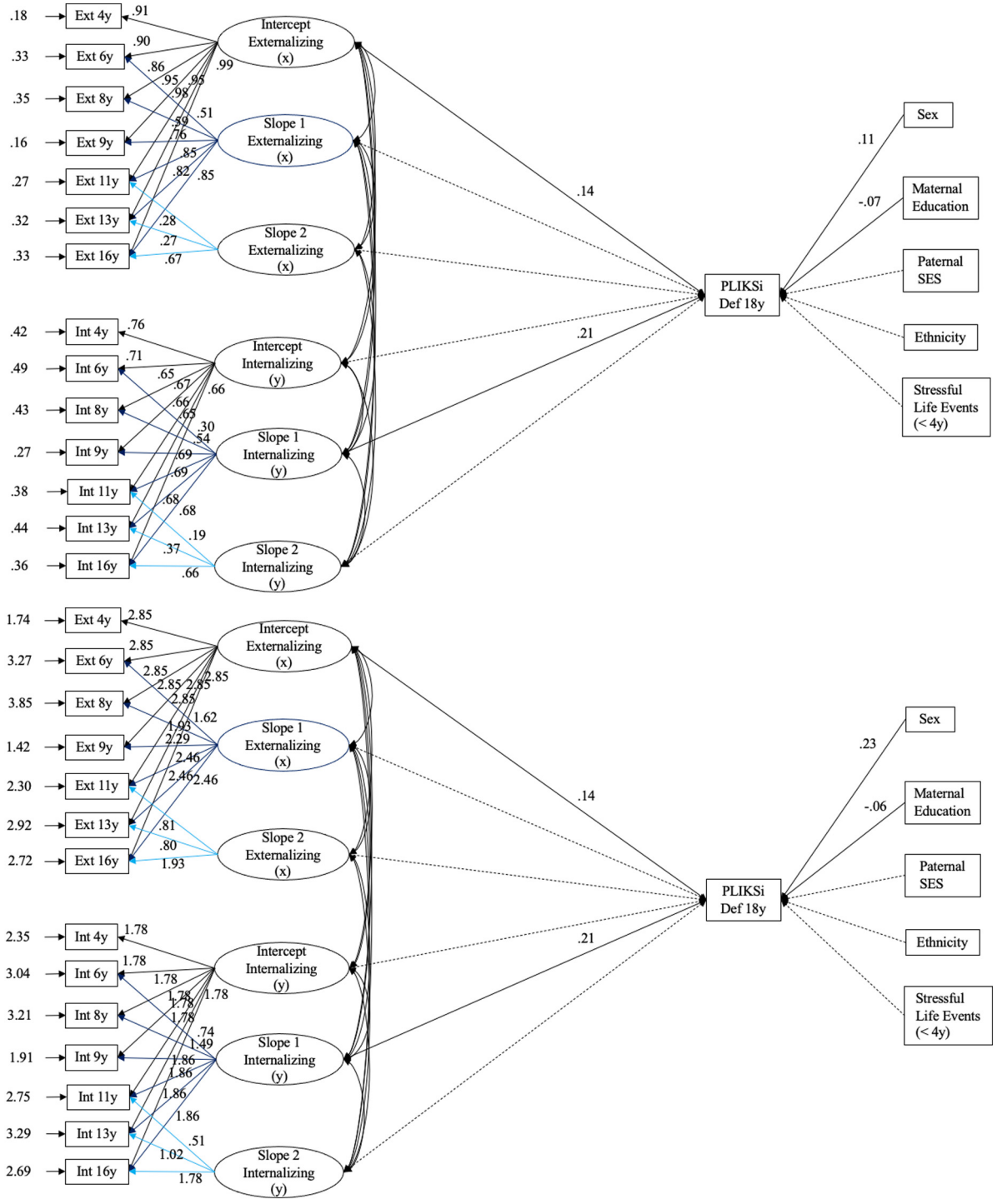

Fig. 2. Two-piece latent growth curve model (2-PGM) of parallel externalizing and internalizing problem behaviors predicting PLEs at 18 years controlling for covariates assessed before age 4 years with standardized (above) and unstandardized (below) betas.

and slope of adolescent externalizing problems ($p = .407$) however, did not predict PLEs at 18 years. Of the covariates included, gender significantly predicted PLEs at 18 years, where females were more likely than males to be in the definite/suspected PLEs group ($b = 0.228$, $p = .001$), as did lower maternal education ($b = -0.064$, $p = .033$). This final model estimating childhood and adolescent levels and changes in levels of internalizing and externalizing psychopathology was an excellent fit, explaining 9.5% of the variance in PLEs at age 18 years (see Fig. 2 for the standardized and unstandardized model results).

4. Discussion

4.1. Main findings

In this large-scale study of modelling childhood (4–9 years) and adolescent (11–16 years) trajectories of internalizing and externalizing problems simultaneously using two-piece growth modelling (2-PGM), we found that baseline externalizing problems at age 4 years and changes in internalizing problems in childhood predicted psychotic-

like experiences (PLEs) at age 18 years, above and beyond baseline internalizing and changes of either type of problems in adolescence. These findings suggest that information about the changes in emotional problems in childhood (4–9 years) and about the level of externalizing problems as early as 4 years of age, rather than information about mental health in adolescence, has greater utility in predicting clinician-assessed PLEs in young-adulthood.

We argue that high levels of externalizing problems – hyperactivity and conduct problems – very early in childhood and increasingly more internalizing problems– emotional symptoms and peer problems - in childhood may represent a set of prodrome symptoms for PLEs. One explanation may be that by age 4 years most of the toddlers with very early externalizing symptoms would have shown symptom reduction, suggesting that those with high levels of externalizing symptoms at age 4 may be those more likely to be in the stable-high group (Fanti and Henrich, 2010). In turn, the persistent trajectory of externalizing behavior, which is also more easily observable than internalizing problems (Bongers et al., 2004; Wolff and Ollendick, 2006), has been associated with prenatal and perinatal medical risks, and these problems have been found to be related to neuropsychological deficits, in turn related to cognitive impairment and PLEs (Gin et al., 2020). Children exhibiting increasing internalizing problems on the other hand are often unable to form good peer relationships and are more likely to engage in isolating behaviors and social withdrawal, related to later PLEs (Matheson et al., 2013). At the same time, internalizing and externalizing problems may also be seen as the product of early childhood adversity, neglect, and abuse (Trotta et al., 2015; Wong et al., 2018) which are speculated to lead to structural and functional brain changes that give rise to schizophrenia-like problems (Cannon et al., 1994). However, if this were a pathway, we would see our effects lose significance after controlling for stressful life events.

Rather than identifying groups of individuals most vulnerable for developing PLEs in young-adulthood based on their childhood trajectories of psychopathology (as a latent class growth analysis would do), this study is the first general-population study in the field of schizophrenia spectrum disorders to use 2-PGM to understand *when* assessments or intervention of comorbid childhood internalizing/externalizing problems may take place in order to reduce PLEs in young-adulthood for the entire population. 2-PGM allowed us to test which development period(s) - childhood or adolescence - (a feature unique to this modelling technique) best predicts PLEs in young-adulthood while controlling for levels and changes in levels of internalizing/externalizing problems across time. To our knowledge, no study to date has applied 2-PGM to modelling trajectories of childhood and adolescent psychopathology to predict PLEs, although this technique has been used in other areas of developmental psychopathology (Jones and Meredith, 2000). Thus, it is our hope that other researchers in the field of schizophrenia will replicate these findings in other samples.

A final rather interesting but unexpected finding from this study is the gender difference in risk of PLEs. Contrary to the literature suggesting that prevalence rates in schizophrenia do not differ between men and women (Ochoa et al., 2012), the young women in our study were more likely than young men to be in the definite PLEs group. Similarly, studies of clinical high-risk populations, on balance, do not document gender differences in the conversion rate to psychosis (Walder et al., 2013), while studies of patient samples do report gender contrasts in the symptom presentation of patients, where women present with more affective problems while men present with more disorganized and negative problems (Cotton et al., 2009). Some explanations for this discrepant finding could be due to methodological differences in both sampling (e.g., community vs patient samples, where gender differences may be more pronounced in the latter group but not in the former) and assessment (e.g., Psychosis-Like Symptom Interview which is not a diagnostic tool vs clinical diagnostic tools). But presently, this remains an unexpected difference and one which would need to be replicated in future studies.

4.2. Strengths & limitations

This study begins to answer how trajectories of change in broad psychopathology across childhood and adolescence may predict psychotic-like experiences in young-adulthood. To our knowledge, this is also the first study to explore this using an analytic approach, two-piece growth modelling, that could appropriately capture the independent contributions of internalizing and externalizing problems across two distinct stages of development. Thus, our study was able to incorporate flexibly transitional periods (in our case, the transition, broadly speaking, to school and that to adolescence), often encountered in longitudinal data. This modelling technique provides a nuanced understanding of potentially critical developmental windows for assessment and intervention. Another strength of this study is the use of a large, general population sample with consistent assessments across 7 timepoints (throughout a 14-year period) – a unique feature of our dataset, ALSPAC.

This study is not without limitations, however. First, although our clinician-assessment PLIKSi at age 18 years is widely used in research, it is not a diagnostic tool. While it is conceivable that PLEs may exist or co-occur with internalizing and externalizing problems earlier in development, as shown in previous studies, PLIKSi at age 18 years in ALSPAC was the most complete and reliable, capturing those who have been 'persistently' experiencing PLEs over the years (Thapar et al., 2012). Second, our effect sizes are small though significant, and thus may be a result of the analyses being overpowered. Third, *why* early externalizing problems and childhood changes in internalizing problems, but not adolescent internalizing/externalizing problems, may be predictive of psychotic-like experiences in young-adulthood remains to be clarified. Fourth, our models do not control for stressful life experiences past age 4 which may arguably influence behaviors across assessment timepoints. Nonetheless, these study findings spanning a wide developmental period of 14 years highlight childhood years as a potential critical developmental window for early assessment and preventive interventions.

Declaration of competing interest

None.

Acknowledgements

We are extremely grateful to all the families who took part in this study, the midwives for their help in recruiting them, and the whole ALSPAC team, including interviewers, computer and laboratory technicians, clerical workers, research scientists, statisticians, volunteers, managers, receptionists and nurses. This publication is the work of the authors. Professor Eirini Flouri, Dr. Keri Wong and Dr. Marta Francesconi will serve as guarantors for the contents of this paper.

CRediT authorship contribution statement

K.W. was involved with conception of the research question, analysing the data, drafting, writing, reviewing, and final approval of the article.

M.F. was involved with drafting, writing, reviewing, and final approval of the article.

E.F. was involved with the management of the project, supervision of the work, writing up, and final approval of the article.

Role of funding source

The UK Medical Research Council and Wellcome (Grant ref: 217065/Z/19/Z) and the University of Bristol provide core support for ALSPAC. This publication is the work of the authors and Professor Eirini Flouri, Dr. Keri Wong and Dr. Marta Francesconi will serve as guarantors for the contents of this paper. A comprehensive list of grants funding is available on the ALSPAC website. This research was specifically funded by the UK Economic and Social Research Council (Grant ref: ES/P001742/1; PI Eirini Flouri). The authors report no biomedical financial interests or potential conflicts of interest.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.schres.2021.03.016.

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