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Pathways between childhood victimization and psychosis-like symptoms in the ALSPAC birth cohort.

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Abstract

Background: Several large population-based studies have demonstrated associations between adverse childhood experiences and later development of psychotic symptoms. However, little attention has been paid to the mechanisms involved in this pathway and the few existing studies have relied on cross-sectional assessments.

Methods: Prospective data on 6,692 children from the UK Avon Longitudinal Study of Parents and Children (ALSPAC) were utilised to address this issue. Mothers reported on children's exposure to harsh parenting and domestic violence in early childhood, and children self-reported on bullying victimization prior to 8.5 years. Presence of children's anxiety at 10 years and their depressive symptoms at 9 and 11 years were ascertained from mothers, and children completed assessments of self-esteem and locus of control at 8.5 years. Children were interviewed regarding psychotic symptoms at a mean age of 12.9 years. Multiple mediation analysis was performed to examine direct and indirect effects of each childhood adversity on psychotic symptoms.

Results: The association between harsh parenting and psychotic symptoms was fully mediated by anxiety, depressive symptoms, external locus of control and low self-esteem. Bullying victimization and exposure to domestic violence had their associations with psychotic symptoms partially mediated by anxiety, depression, locus of control and self-esteem. Similar results were obtained following adjustment for a range of confounders and when analyses were conducted for boys and girls separately.

Conclusions: These findings tentatively suggest that specific cognitive and affective difficulties in childhood could be targeted to minimise the likelihood of adolescents exposed to early trauma from developing psychotic symptoms.

Key words: aetiology/bullying/longitudinal/psychosis/trauma

Introduction

An increasing body of research has demonstrated associations between adverse childhood experiences and psychotic disorders.[1] As psychosis is considered to reflect a quantitative continuum from normality through attenuated psychotic symptoms to full clinical disorder,[2] an underlying aetiological continuum is also assumed to exist.[2] Indeed, childhood adversity has been linked to sub-clinical expressions of psychosis.[3-5] These findings suggest that investigating samples with early manifestations of psychotic symptoms may provide useful insights into psychotic disorders. However, little is known about the mechanisms underlying the adversity - psychosis association. Improved understanding of these pathways is imperative as it may enable suitable interventions to be targeted at high risk children and potentially prevent the emergence of psychotic disorder.

Several pathways are possible. Firstly, traumatic events in childhood could directly increase the risk of developing psychotic symptoms, perceptual aberrations or reality impairment.[6,7] For instance, sub-clinical hallucinations or delusions could be considered to be traumatic reactions to severe adversity whose content is directly reminiscent of the adversity.[7,8] A range of other more indirect pathways have also been suggested. For instance, Garety et al.[9] hypothesised that exposure to trauma in childhood may result in the development of negative beliefs about the self as vulnerable to threat. These negative schematic beliefs may in turn lower self-esteem and produce a tendency to attribute experiences to external causes, potentially giving rise to referential ideas, paranoia and misattributions of perceptual anomalies.[9,10] Indeed, both low self-esteem and an external locus of control have been shown to increase the risk of psychotic symptoms in prospective studies.[11,12] Other forms of psychopathology resulting from early victimization may also form a pathway to later psychotic symptoms. Adverse childhood experiences have been shown to

predict later depression and anxiety[13,14] and these symptoms in turn appear to precede psychosis.[15,16]

Further exploration of the pathways between childhood adversity and psychosis is warranted to test these postulated mechanisms. The handful of studies that have explored this issue to date[17-20] have all utilised cross-sectional designs with reliance on retrospective assessments of childhood adversity and potential mediators, thus preventing temporal relationships from being accurately established. Therefore, we investigated cognitive and affective pathways between a range of early adverse childhood experiences and psychotic symptoms in a prospective longitudinal study, the Avon Longitudinal Study of Parents and Children (ALSPAC). It has previously been demonstrated in this sample that bullying by peers is associated with greater endorsement of psychotic symptoms at around 13 years of age[5] and other studies have also found that early exposure to harsh parenting[3] and domestic violence within the family home[21] are related to the experience of psychotic symptoms in early adolescence. We considered it important to look at these types of victimization separately as they involve different perpetrators (parental figures vs. peers) or different degrees of exposure (direct vs. witnessing) and thus may potentially have different developmental effects.[22,23] We examined these exposures in early childhood and hypothesised that low self-esteem, an external locus of control, and higher levels of depression and anxiety in the intervening period would constitute indirect pathways between childhood victimization and psychotic symptoms.

Method

Participants

The sample was drawn from the Avon Longitudinal Study of Parents and Children (ALSPAC) which recruited 14,541 pregnant women resident in the former Avon Health

Authority in the southwest of England, with expected dates of delivery 1st April 1991 to 31st December 1992. There were 186 twin pairs in this sample and the twin with the lowest birth weight was removed from the dataset because this factor has previously been shown to have associations with psychotic symptoms in this cohort.[24] This also avoided the potentially confounding effect of the non-independence of observations provided on twins. Ethical approval for the study was obtained from the ALSPAC Law and Ethics Committee and the Local Research Ethics Committees. Parents provided informed written consent and children assent after receiving a full explanation of the study.

Measures

Victimization.

Mothers reported via a series of postal questionnaires on a range of life events and victimization experiences that their children had been exposed to since birth. Specifically, when the child was aged 8, 21, 33, 47, 61 and 73 months mothers were asked whether the following had occurred since the last assessment (or since birth for the first assessment point): "Your husband/partner was physically cruel to you"; and "Your husband/partner was emotionally cruel to you". A positive response to either of these two questions at any of the time-points was considered to be evidence of domestic violence (see Bowen et al.[25] for further details).

Maternal hitting was considered present if mothers responded with 'daily' or 'every week' to the following item: 'When you are at home with your child how often do you slap him' when the child was aged 2 or 3.5 years.[26] Preschool hostility was classed as present if 3 or all of the following items were answered positively by mothers: 'mum feels that whining makes her want to hit child' (1.8 years); 'mum often irritated by child' (1.8 years); 'mum has battle of wills with child' (1.8 years); and 'child gets on mums nerves' (1.8 years).[26] School hostility (since the age of 5) was considered present if all of the following 3 items were

answered positively by mothers: 'mum often irritated by child' (7 years); 'mum has battle of wills with child' (7 years); and 'child gets on mum's nerves' (7 years).[26] These items have previously been shown to load onto a distinct hostility factor.[26] A harsh parenting composite was constructed by summing maternal hitting, preschool and school hostility, and coded as: none; mild (1 indicator of harsh parenting); moderate (2 indicators of harsh parenting) or severe (3 indicators of harsh parenting). This composite has previously been demonstrated to be associated with borderline personality disorder symptoms in this sample.[27]

Children were interviewed with the Bullying and Friendship Interview Schedule[28] when they were on average 8.5 years of age as part of a face-to-face assessment clinic (see Griffiths et al.[29] for a detailed description of its use in the ALSPAC sample). Trained psychology graduates asked the children 10 questions concerning overt and relational bullying by peers over the previous 6 months and the frequency of its occurrence. Children were classified as having been severely bullied if they reported exposure to both overt and relational victimization at least four times each during the past 6 months or at least once a week for each type during this time period, while those who had only experienced one of these forms of bullying at this level of frequency were considered to have been moderately bullied, and all the remaining children were classified as not having been bullied. Reasonable levels of agreement have been demonstrated between child self-reports of bullying and those provided by mothers and teachers.[5]

Locus of Control.

Children completed a 12-item version of the Nowicki-Strickland Internal-External scale (NSIE)[30] during face-to-face assessments when they were on average 8.5 years of age. A total score was created by summing scores for all of the items, with a higher score indicating a more external locus of control (LoC). Children who responded 'don't know' to a question

were coded as having an unknown LoC score and thus excluded from analyses that included this variable (see Thompson et al.[12] for full details).

Self-esteem.

Children also completed a shortened form of Harter's Self Perception Profile for Children[31] when they were on average 8.5 years old as part of the face-to-face assessment clinic. This version consisted of the 12 items from the global self-worth and scholastic competence subscales of the original measure. To avoid overlap between scholastic competence and IQ, only the global self-worth subscale was utilised in the present analysis and this was calculated by summing the scores for the 6 relevant items, with lower scores indicating poorer self-esteem.

Affective symptoms.

Parents completed the Development and Well-being Assessment (DAWBA)[32] when children were aged 10 years-old. This semi-structured interview comprises open and closed questions about a range of symptoms relevant to childhood psychiatric disorders. An ordered categorical measure of anxiety was generated using computer algorithms (see Goodman et al.[33] for further details). This comprised 6 categories indicating the likelihood of each child having an anxiety disorder from level 0 (<0.1% of children in this band have anxiety disorder) up to level 5 (>70% of children in this band have anxiety disorder). Goodman et al.[33] have validated this measure of anxiety in epidemiological samples of British and Norwegian children. There was one child who was reported to be experiencing post-traumatic symptoms and so this individual was removed from the analysis.

Additionally, mothers completed the Short Moods and Feelings Questionnaire (SMFQ)[34] when the child was aged 9 and 11 years to provide a broader picture of the depressive symptoms their child had experienced over the previous 2 weeks. The SMFQ

comprises 13 questions rated on a 3-point scale: true (score of 2), sometimes true (score of 1), and not true (score of 0). The ratings for all of the items were summed to produce a total score out of 26. In accordance with the guidance set out by Angold et al.,[34] the scores at each time point were dichotomised into no/minimal depression (scores of 0-7) and clinically relevant depressive symptoms (scores of 8 or more). For the current analysis a variable was constructed indicating the presence of clinically relevant depressive symptoms at either 9 or 11 years versus absence of such symptoms at both time points.

Psychotic symptoms.

At a mean age of 12.9 years, children were administered a semi-structured psychosis interview (PLIKSi)[35] derived from the Diagnostic Interview Schedule for Children version IV (DISC-IV)[36] and the Schedules for Clinical Assessment in Neuropsychiatry version 2.0 (SCAN).[37] The PLIKSi comprises 12 core questions concerning the occurrence of hallucinations, delusions and thought interference over the previous 6 months. Trained interviewers rated each symptom as absent, suspected or definitely present, with the latter rating requiring a credible example to have been provided. The average kappa value was 0.72 indicating good inter-rater reliability for this measure.[35] In the current analysis only symptoms that were not attributable to the effects of sleep, fever or substance misuse were included in accordance with previous studies utilising this sample.[38] Two PLIKSi outcomes were examined: presence or absence of (i) any suspected or definite psychotic symptoms ('broad' symptoms); and (ii) definite symptoms only ('narrow' symptoms).

Confounders.

Parent-reported ethnicity (split into White and non-White due to small numbers in more specific ethnic groupings) and sex of the child were included as potential confounders as they have previously been shown to be differentially associated with both childhood adversity and

psychosis.[4,39,40] Birth weight was obtained from birth records and lower birth weight has been found to predict greater likelihood of childhood maltreatment[41] and PLIKSi symptoms[24] in this sample. Intelligence quotient (IQ) was derived from the alternative item form of the Wechsler Intelligence Scale for Children 3rd UK edition (WISC-III)[42] administered to children at around 8.5 years of age. The total IQ score was dichotomised into below average (89 or less) and average or higher (90 or more) as children in this sample with below average IQ scores have previously been shown to be at the greatest risk of experiencing psychotic symptoms.[35] Family psychiatric history was reported by the child's parents via postal questionnaires completed during pregnancy and up until the child was 11 years of age. A history of schizophrenia in the biological parents or grandparents of the child, depression (i.e., severe symptoms, seen a doctor for depression or prescribed anti-depressants) or suicide attempts in the parents was included as a potential confounder as this has also been reported to be associated with elevated rates of childhood trauma[3] and psychotic symptoms.[38] Finally, a Family Adversity Index (FAI)[25] was included to account for the impact of multiple family risk factors. This comprised 17 items drawn from questionnaires completed by the mothers during their pregnancy (8, 12, 18 and 32 weeks gestation) including young maternal age, inadequate housing, financial difficulties, maternal affective disorder, parental substance abuse and involvement in crime. The presence of each adversity was rated as 1 and a total FAI score was produced by summing all 17 items.

Analysis.

Basic associations between each form of victimization and broad or narrow PLIKSi symptoms were investigated using binary logistic regression. Multiple mediation analysis was then performed in Stata (v11.0) to examine the extent to which each of these associations was mediated by the affective (depression and anxiety) and cognitive (locus of control and self-esteem) variables. A diagrammatic representation of the model tested is presented in Figure 1.

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The potential mediators were demonstrated to be statistically distinct from each other (data not shown) and thus were utilised as separate constructs. The meditational variables were first entered altogether to examine their combined effect on the association between each type of victimization and PLIKSi symptoms and then secondly they were entered on their own in separate models to investigate their individual impact on this relationship. The *binary_mediation* command was employed which can be used with a combination of dichotomous and continuous variables and provides standardised coefficients. Confidence intervals were estimated using bootstrapping with 500 replications. All logit coefficients and confidence intervals were exponentiated into odds ratios to facilitate interpretation and comparison between models. The final pathway models were adjusted for the potential confounding effects of sex, ethnicity, birth weight, family history of schizophrenia, depression or suicide, the child's IQ, and general family adversity. Analyses were repeated for boys and girls separately to determine if similar pathways were evident.

[Insert Figure 1 here]

Results

Data were available on 6,692 children who completed the PLIKSi at an average age of 12.9 years (48% of the 14,062 live births in this cohort). Approximately half of this sample were female (50.9%) and few were of non-White ethnic origin (3.6%). Children who completed the PLIKSi were more likely to be female, of White ethnicity, born to married mothers, have been exposed to lower levels of family adversity and have a higher IQ than those who did not complete it (data not shown but see Schreier et al.[5] for results on a slightly smaller subsample). Rates of all types of victimization were similar between PLIKSi completers and non-completers.

Of those with PLIKSi data, 11.3% reported probable or definite symptoms ('broad') that were not due to sleep, fever or substance use and 4.7% were considered to have definite

symptoms ('narrow'), again not attributable to the aforementioned causes. Almost a quarter of PLIKSi completers had been exposed to domestic violence prior to 6 years of age (23.6%), 37.0% had experienced mildly, 9.9% moderately, and 4.2% severely harsh parenting prior to 7 years of age, while 10.1% of children reported having been severely bullied prior to 8.5 years of age. The strongest associations with psychotic symptoms were apparent for severe bullying victimization (broad: OR=1.47, 95% CI 1.30-1.65; narrow: OR=1.51, 95% CI 1.27-1.80) and exposure to domestic violence (broad: OR=1.48, 95% CI 1.25-1.76; narrow: OR=1.59, 95% CI 1.23-2.04), with the smallest effects for harsh parenting (broad: OR=1.13, 95% CI 1.02-1.25; narrow: OR=1.15, 95% CI 0.99-1.34).

Pathways to psychotic symptoms

The direct and indirect pathways (via potential affective and cognitive mediators) between each form of victimization and broadly and narrowly defined PLIKSi symptoms are presented in Tables 1 and 2, respectively. The odds ratio (*OR*) for each pathway is shown, along with 95% confidence intervals, both unadjusted and adjusted for sex, ethnicity, birth weight, family psychiatric history, child's IQ and general family adversity. The proportion of the total effect of each form of victimization on PLIKSi symptoms that is accounted for by all of the mediators together and individually is displayed in red in Figures 2 and 3 (for broadly and narrowly defined symptoms, respectively).

[Insert Tables 1 & 2 and Figures 2 & 3 here]

The relatively modest association between harsh parenting and PLIKSi symptoms was entirely accounted for by the mediators. Specifically, harsh parenting was indirectly associated with both broadly and narrowly defined PLIKSi symptoms through clinically

relevant depressive symptoms, and to a lesser extent via external locus of control, low self-esteem and level of anxiety. The strength of these indirect pathways remained largely unchanged after adjustment.

The association between exposure to domestic violence and psychotic symptoms was similar for suspected and definite psychotic symptoms but was attenuated after adjustment for confounders. Approximately a third of the total effect was accounted for by depressive symptoms and, to a lesser extent, level of anxiety, external locus of control and low self-esteem. Adjusting for confounders explained slightly more of the effect for both broad and narrow PLIKSi symptoms.

Bullying victimization demonstrated the most robust association with both broad and narrow PLIKSi symptoms. Indirect pathways between bullying victimization and psychotic symptoms were apparent mainly via having an external locus of control, and to a lesser degree via low self-esteem, depressive symptoms, and level of anxiety. Around a third of the total effect of bullying victimization on PLIKSi symptoms was accounted for by these mediators. The results were largely unchanged when confounders were included in these models.

The mediating effects of the affective and cognitive factors were broadly similar when examined for boys and girls separately (see Supplementary Tables 1 and 2). However, amongst boys, only around two-thirds of the effect of harsh parenting on narrowly defined psychotic symptoms was accounted for when all of the mediators were included in the model together whereas there appeared to be a much stronger meditational pathway to these definite PLISKi symptoms following exposure to domestic violence than there was for girls.

Discussion

This large longitudinal study is the first to investigate psychological and affective pathways between different forms of victimization and psychotic symptoms in adolescents utilising

prospectively obtained and temporally ordered assessments. Across the whole sample, the weak effect of harsh parenting in childhood on psychotic symptoms in early adolescence was entirely accounted for by the presence of depressive symptoms, level of anxiety, having an external locus of control and low self-esteem in the intervening period. These pathways also seemed to be involved in the appearance of psychotic symptoms following exposure to bullying or domestic violence but accounted for smaller proportions of the overall effects. These results were similar for both suspected and definite psychotic symptoms, following adjustment for a range of confounders and also when examined separately for boys and girls. These findings are consistent with previous cross-sectional analyses that demonstrated mediation of victimization-psychosis associations via psychological and affective factors.[17-20]

A substantial proportion of the association between bullying or domestic violence and psychotic symptoms was not mediated by affective or psychological factors. This could indicate 'direct' traumatic reactions to these victimizations in the form of increased suspiciousness of others or detachment from reality.[6,7] Alternatively, the unexplained portion of the associations could represent residual confounding or mediating factors that were not measured in the current study. For example, hostile attribution biases have been hypothesised to arise from early adverse experiences and may increase the risk for developing persecutory delusions.[9,10] Anxiety is also postulated to form a major pathway between victimization and psychosis[18] and it is possible that using a categorical measure of the likelihood of having a clinically diagnosed disorder in the present study did not capture an appropriate range of anxiety symptoms to detect a more substantial pathway for bullying and domestic violence. Another possibility is that as reports of exposure to bullying were obtained fairly close to the assessment of affective and cognitive mechanisms, this form of victimization may not have had sufficient time to have a major impact upon the child's psychological functioning. This is especially likely to be the case for locus of control which is a fairly stable personality trait and

is more likely to be altered following long-term rather than short-term victimization.[43] A range of other potential mechanisms may also be involved in the development of psychotic symptoms following exposure to early victimization (e.g., epigenetic changes, interactions with genetic vulnerabilities, dysregulation of the HPA axis, post-traumatic stress disorder, stunted brain development, substance misuse) but these were beyond the scope of this paper. The slight gender difference found for pathways to narrowly defined psychotic symptoms is intriguing and requires further investigation in independent samples.

Although the assessments were prospectively obtained some (particularly bullying and the psychological mediators) were reasonably close together and thus there may have been some overlap in the timing of the experiences. Moreover, the possibility of reverse causality cannot be completely ruled out as the mediating variables and psychotic symptoms were not additionally assessed prior to the victimization exposures. However, it would have been difficult to reliably obtain these variables at younger ages. Additionally, the measure of harsh parenting was only available for mothers and, although domestic violence occurred within the family home after the child was born, it is not possible to ascertain whether the child was definitely present during incidences of domestic violence. These aspects limit the generalisability of the findings. There was also missing data on several of the confounding factors resulting in reduced sample sizes for the adjusted analyses, though previous analysis of this cohort has shown that selective dropout has only a minimal impact on associations between predictors and outcomes.[44] Finally, the psychotic symptoms were only assessed for their presence over the previous 6 months and for many of these children these phenomena may be transitory. Future research is therefore required to both replicate the current findings in other longitudinal cohorts as well as to investigate whether similar mechanisms also operate for persistent psychotic symptoms which index an even greater risk for the development of psychotic disorders.[45]

Nevertheless, these findings tentatively suggest that specific cognitive and affective difficulties in childhood could be targeted to minimise the likelihood of adolescents exposed to early trauma from developing sub-clinical psychosis. Clearly replication is required before these findings can be translated into clinical practice but preliminary studies indicate some beneficial effects of cognitive behaviour therapy in victimised children.[46] Moreover, our findings highlight the importance of prevention programmes to reduce bullying victimization and exposure to domestic violence in order to minimise the appearance of psychotic symptoms in early adolescence.

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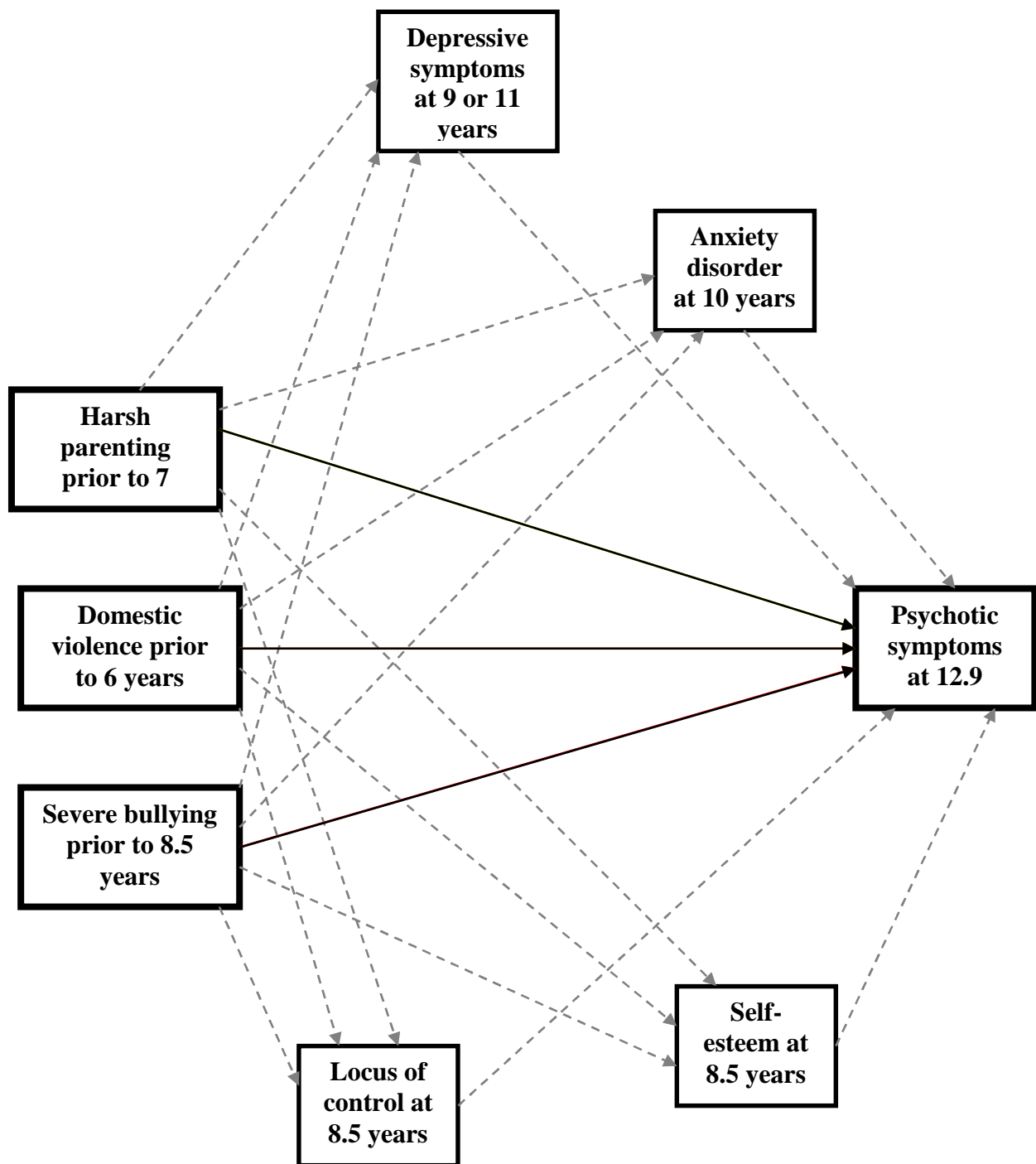
Figure 1. Conceptual path diagram of associations between victimization and psychotic symptoms. Hypothesised direct paths are indicated by solid arrows and indirect paths by dashed arrows.

Panel A: Mediation of the effect of harsh parenting on suspected psychotic symptoms

Percentage of total effect of harsh parenting on psychotic symptoms
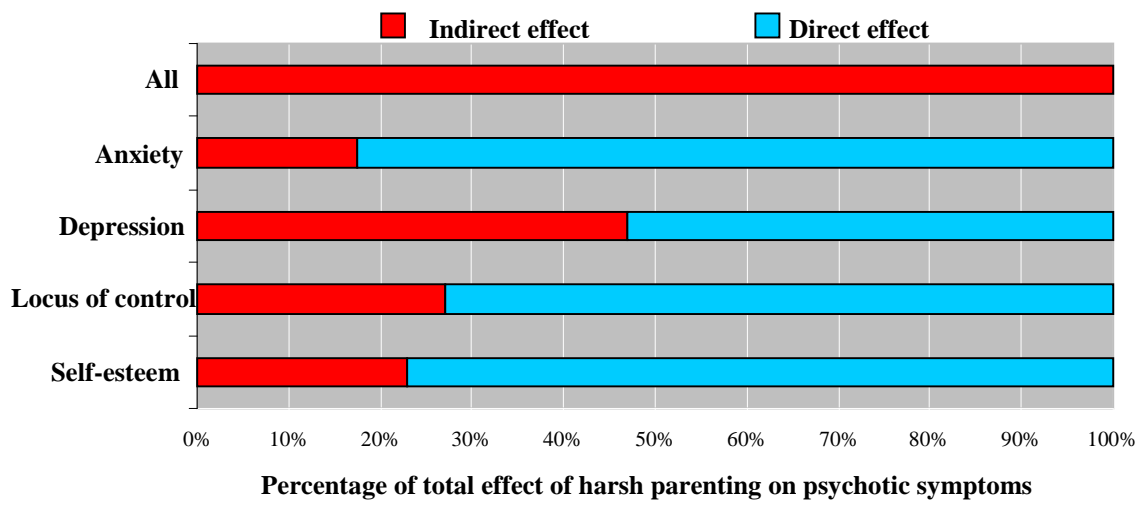
Panel B: Mediation of the effect of domestic violence on suspected psychotic symptoms

Percentage of total effect of domestic violence on psychotic symptoms
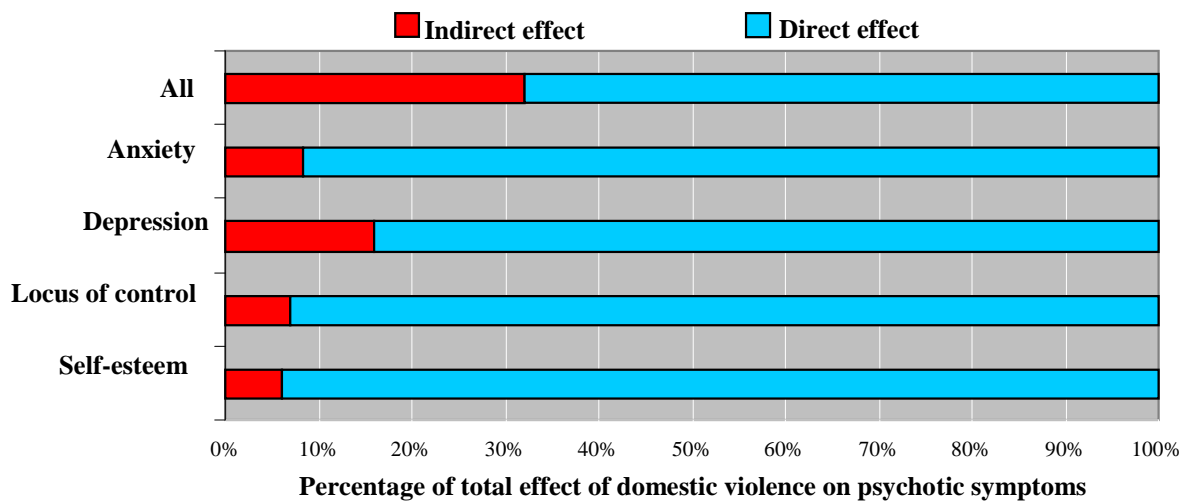
Panel C: Mediation of the effect of bullying victimization on suspected psychotic symptoms

Percentage of total effect of bullying victimization on psychotic symptoms
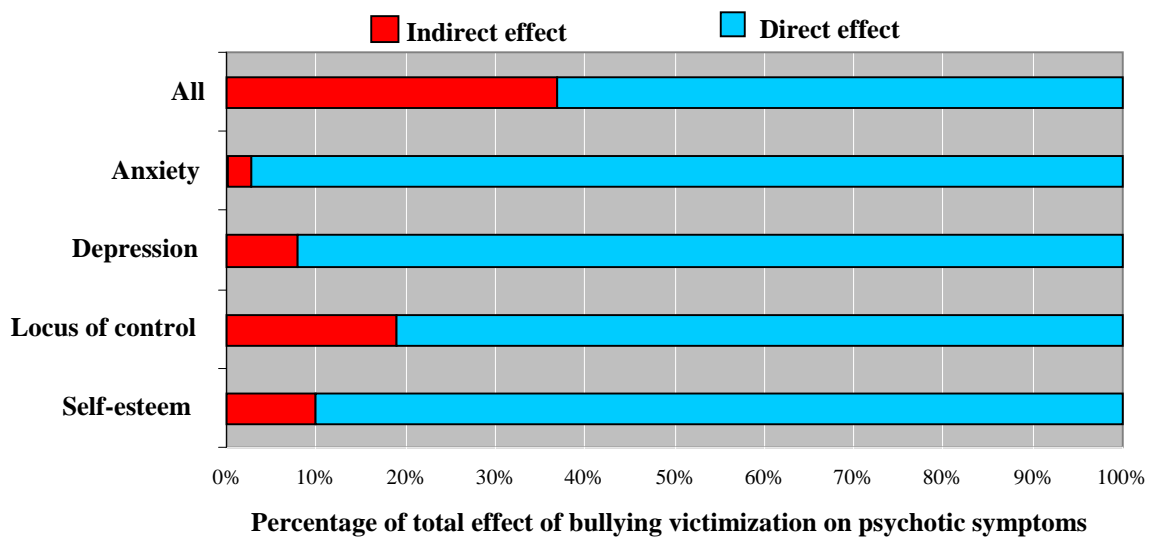
Figure 2. Proportion of the total effect of harsh parenting (Panel A), exposure to domestic violence (Panel B), and bullying victimization (Panel C) in childhood on *broadly* defined psychotic symptoms at 12.9 years of age mediated via affective and cognitive factors. The red portion of each bar indicates the percentage of the effect mediated (indirect effect), initially by all of the factors together and then separately for anxiety disorder, depressive symptoms, external locus of control and low self-esteem.

Panel A: Mediation of the effect of harsh parenting on definite psychotic symptoms

Percentage of total effect of harsh parenting on psychotic symptoms
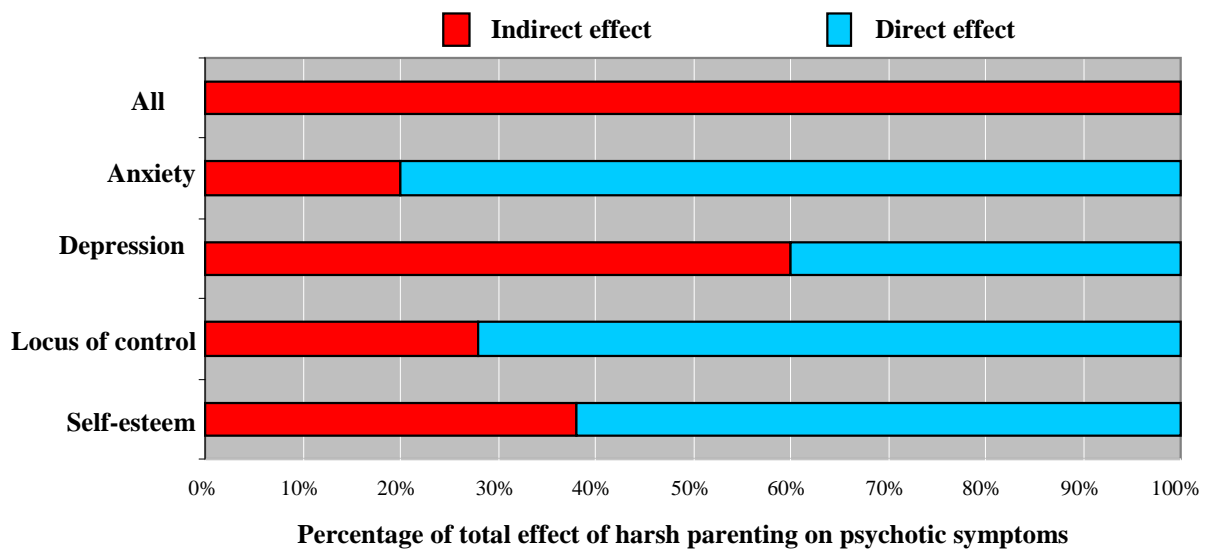
Panel B: Mediation of the effect of domestic violence on definite psychotic symptoms

Percentage of total effect of domestic violence on psychotic symptoms
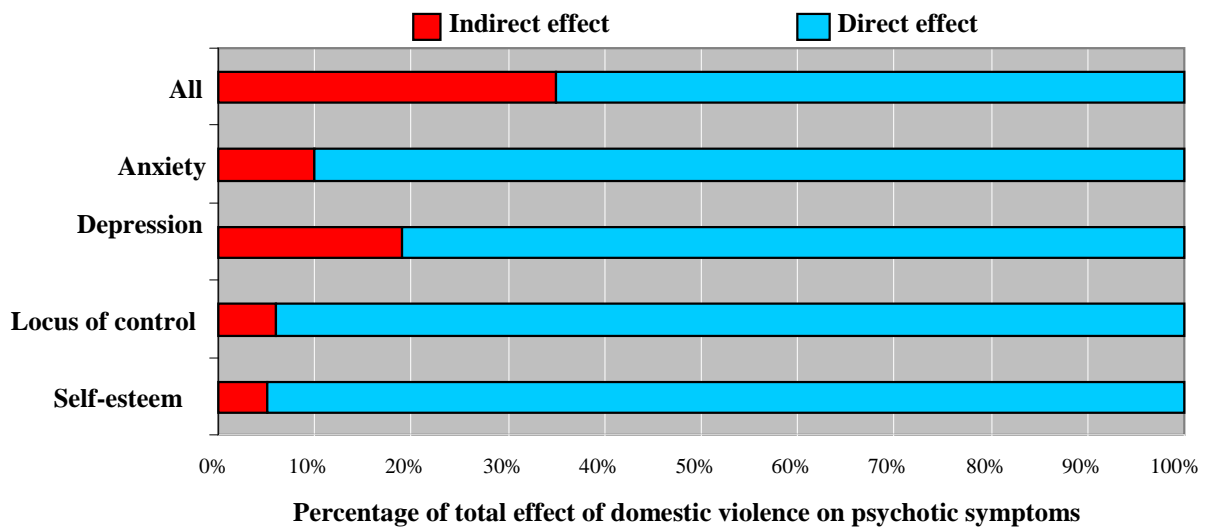
Panel C: Mediation of the effect of bullying victimization on definite psychotic symptoms

Percentage of total effect of bullying victimization on psychotic symptoms

25
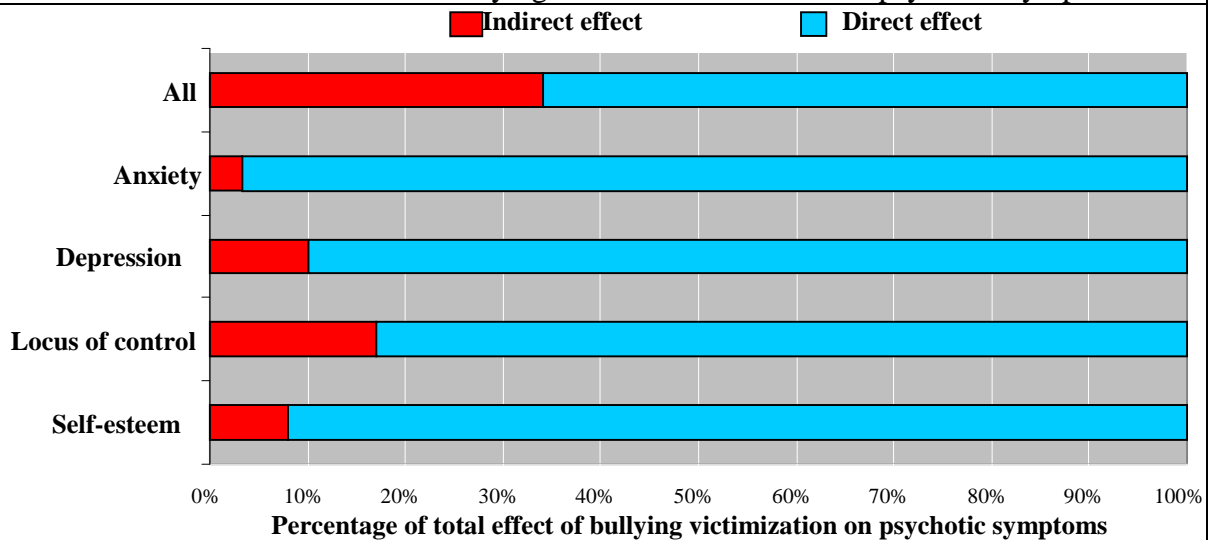
Figure 3. Proportion of the total effect of harsh parenting (Panel A), exposure to domestic violence (Panel B), and bullying victimization (Panel C) in childhood on *narrowly* defined psychotic symptoms at 12.9 years of age mediated via affective and cognitive factors. The red portion of each bar indicates the percentage of the effect mediated (indirect effect), initially by all of the factors together and then separately for anxiety disorder, depressive symptoms, external locus of control and low self-esteem.

Table 1. Associations between different forms of victimization and *broadly* defined psychotic symptoms, split into total effects, direct and indirect pathways via all of the potential mediators together and then via each individual mediator on its own.

| Type of victimization & potential mediator	Unadjusted				Adjusted[a]			
	Total OR (95% CI)	Direct OR (95% CI)	Indirect OR (95% CI)	% mediated	Total OR (95% CI)	Direct OR (95% CI)	Indirect OR (95% CI)	% mediated
Harsh parenting	*N=5143*				*N=4494*			
All mediators	1.05 (0.99 – 1.10)	1.00 (0.95 – 1.06)	1.05 (1.03 – 1.06)	100	1.02 (0.95 – 1.08)	0.98 (0.92 – 1.04)	1.04 (1.02 – 1.05)	100
Anxiety only	1.05 (0.99-1.09)	1.04 (0.99-1.09)	1.01 (1.00-1.01)	17	1.03 (0.98-1.08)	1.02 (0.97-1.08)	1.00 (1.00-1.01)	16
Depression only	1.06 (1.01-1.11)	1.03 (0.98-1.08)	1.03 (1.01-1.04)	47	1.04 (0.99-1.09)	1.01 (0.96-1.07)	1.03 (1.01-1.03)	60
LoC only	1.06 (1.00-1.11)	1.04 (0.99-1.09)	1.02 (1.01-1.02)	27	1.03 (0.98-1.09)	1.02 (0.97-1.07)	1.01 (1.01-1.02)	36
Self-esteem only	1.05 (1.00-1.10)	1.04 (0.99-1.09)	1.01 (1.01-1.02)	23	1.03 (0.98-1.08)	1.02 (0.97-1.07)	1.01 (1.00-1.02)	33
Domestic violence	*N=5781*				*N=4904*			
All mediators	1.08 (1.02 – 1.13)	1.05 (1.00 – 1.11)	1.03 (1.01 – 1.04)	32	1.04 (0.98 – 1.10)	1.02 (0.96 – 1.08)	1.02 (1.01 – 1.03)	48
Anxiety only	1.10 (1.05-1.14)	1.09 (1.04-1.13)	1.01 (1.oo-1.01)	9	1.04 (0.99-1.10)	1.04 (0.99-1.10)	1.00 (1.00-1.01)	9
Depression only	1.10 (1.06-1.14)	1.08 (1.04-1.13)	1.02 (1.01-1.02)	16	1.03 (0.98-1.08)	1.02 (0.97-1.07)	1.01 (1.00-1.01)	23

LoC only	1.08 (1.02-1.13)	1.07 (1.02-1.12)	1.01 (1.00-1.01)	7	1.02 (0.97-1.08)	1.02 (0.97-1.08)	1.00 (1.00-1.01)	2
Self-esteem only	1.09 (1.04-1.13)	1.08 (1.04-1.13)	1.01 (1.00-1.01)	6	1.03 (0.98-1.09)	1.03 (0.98-1.08)	1.00 (1.00-1.01)	9
Bullying	*N=5136*				*N=4622*			
All mediators	1.14 (1.08 – 1.20)	1.09 (1.03 – 1.14)	1.05 (1.03 – 1.07)	37	1.13 (1.06 – 1.19)	1.09 (1.02 – 1.15)	1.04 (1.02 – 1.06)	31
Anxiety only	1.14 (1.09-1.19)	1.14 (1.09-1.19)	1.00 (1.00-1.01)	3	1.13 (1.08-1.19)	1.13 (1.08-1.19)	1.00 (1.00-1.01)	1
Depression only	1.15 (1.10-1.20)	1.14 (1.09-1.19)	1.01 (1.00-1.02)	8	1.14 (1.09-1.19)	1.13 (1.08-1.18)	1.01 (1.00-1.02)	7
LoC only	1.15 (1.10-1.20)	1.12 (1.07-1.17)	1.03 (1.02-1.04)	19	1.14 (1.09-1.19)	1.12 (1.06-1.17)	1.02 (1.01-1.03)	16
Self-esteem only	1.14 (1.10-1.20)	1.13 (1.08-1.18)	1.01 (1.01-1.02)	10	1.14 (1.09-1.19)	1.13 (1.07-1.18)	1.01 (1.00-1.02)	9

CI, confidence interval. LoC, locus of control. OR, odds ratio.

[a] Adjusted for sex, ethnicity, birth weight, family psychiatric history, IQ and general family adversity.

Table 2. Associations between different forms of victimization and *narrowly* defined psychotic symptoms, split into total effects, direct and indirect pathways via all of the potential mediators together and then via each individual mediator on its own.

Type of victimization & potential mediator	Unadjusted				Adjusted[a]			
	Total OR (95% CI)	Direct OR (95% CI)	Indirect OR (95% CI)	% mediated	Total OR (95% CI)	Direct OR (95% CI)	Indirect OR (95% CI)	% mediated
Harsh parenting	*N=5150*				*N=4621*			
All mediators	1.03 (0.94 – 1.12)	0.98 (0.89 – 1.06)	1.06 (1.03 – 1.08)	100	1.01 (0.93 – 1.09)	0.97 (0.89 – 1.05)	1.04 (1.02 – 1.07)	100
Anxiety only	1.05 (0.98-1.14)	1.04 (0.97-1.22)	1.01 (1.00-1.02)	20	1.03 (0.93-1.11)	1.02 (0.93-1.10)	1.01 (1.00-1.01)	21
Depression only	1.06 (0.99-1.13)	1.03 (0.95-1.10)	1.03 (1.02-1.06)	60	1.03 (0.96-1.10)	1.00 (0.93-1.08)	1.03 (1.01-1.05)	94
LoC only	1.05 (0.97-1.13)	1.04 (0.96-1.12)	1.01 (1.01-1.02)	28	1.02 (0.94-1.10)	1.01 (0.93-1.09)	1.01 (1.00-1.02)	47
Self-esteem only	1.04 (0.98-1.13)	1.03 (0.98- 1.13)	1.01 (1.00-1.01)	38	1.01 (0.94-1.08)	1.00 (0.93-1.07)	1.01 (1.01-1.02)	97
Domestic violence	*N=5780*				*N=4903*			
All mediators	1.08 (0.99 – 1.17)	1.05 (0.97 – 1.13)	1.03 (1.01 – 1.04)	35	1.06 (0.97 – 1.14)	1.03 (0.95 – 1.11)	1.02 (1.01 – 1.04)	42
Anxiety only	1.12 (1.04-1.19)	1.10 (1.03-1.18)	1.01 (1.00-1.02)	10	1.06 (0.97-1.15)	1.06 (0.97-1.14)	1.00 (1.00-1.01)	8
Depression only	1.11 (1.05-1.18)	1.09 (1.03-1.16)	1.02 (1.01-1.03)	19	1.05 (0.96-1.13)	1.04 (0.96-1.12)	1.01 (1.00-1.02)	18

	1.09	1.08	1.01	6	1.03	1.03	1.00	1
LoC only	(1.02-1.17)	(1.01-1.16)	(1.00-1.01)		(0.95-1.11)	(0.95-1.11)	(1.00-1.01)	
Self-esteem only	1.12	1.11	1.01	5	1.04	1.04	1.00	7
	(1.05-1.19)	(1.04-1.19)	(1.00-1.01)		(0.97-1.12)	(0.97-1.12)	(1.00-1.01)	
Bullying		*N=5150*				*N=4621*		
All mediators	1.15	1.10	1.05	34	1.14	1.10	1.04	29
	(1.06 – 1.24)	(1.01 – 1.19)	(1.03 – 1.07)		(1.03 – 1.24)	(1.00 – 1.19)	(1.02 – 1.06)	
Anxiety only	1.15	1.14	1.00	3	1.14	1.14	1.00	2
	(1.07-1.23)	(1.06-1.22)	(1.00-1.01)		(1.04-1.22)	(1.04-1.22)	(1.00-1.01)	
Depression only	1.17	1.15	1.02	10	1.15	1.14	1.01	8
	(1.08-1.24)	(1.06-1.23)	(1.01-1.02)		(1.06-1.24)	(1.05-1.22)	(1.00-1.02)	
LoC only	1.17	1.14	1.03	17	1.15	1.13	1.02	13
	(1.08-1.23)	(1.05-1.20)	(1.02-1.04)		(1.06-1.24)	(1.04-1.22)	(1.01-1.03)	
Self-esteem only	1.16	1.14	1.02	8	1.14	1.13	1.01	10
	(1.07-1.23)	(1.06-1.22)	(1.00-1.02)		(1.05-1.22)	(1.04-1.21)	(1.00-1.02)	

CI, confidence interval. LoC, locus of control. OR, odds ratio.
[a] Adjusted for sex, ethnicity, birth weight, family psychiatric history, IQ and general family adversity.

Supplementary Table 1. Associations between different forms of victimization and *broadly* defined psychotic symptoms, split into total effects, direct and indirect pathways via all of the potential mediators together and then via each individual mediator on its own, presented for boys and girls separately.

Type of victimization & potential mediator	Unadjusted				Adjusted[a]			
	Total OR (95% CI)	Direct OR (95% CI)	Indirect OR (95% CI)	% mediated	Total OR (95% CI)	Direct OR (95% CI)	Indirect OR (95% CI)	% mediated
Harsh parenting	*Boys: N=2524*	*Girls: N=2619*			*Boys: N=2189*	*Girls: N=2305*		
All mediators								
Boys	1.03 (0.94-1.12)	0.99 (0.90-1.08)	1.04 (1.02-1.06)	100	1.01 (0.92-1.11)	0.98 (0.90-1.07)	1.03 (1.01-1.06)	100
Girls	1.06 (0.98-1.14)	1.01 (0.94-1.08)	1.05 (1.03-1.08)	86	1.02 (0.95-1.10)	0.98 (0.91-1.05)	1.04 (1.02-1.07)	100
Anxiety only								
Boys	1.02 (0.93-1.09)	1.01 (0.93-1.08)	1.01 (1.00-1.01)	41	1.01 (0.93-1.10)	1.01 (0.92-1.10)	1.00 (1.00-1.01)	26
Girls	1.08 (1.01-1.15)	1.07 (1.00-1.15)	1.01 (0.99-1.01)	13	1.03 (0.96-1.10)	1.03 (0.96-1.10)	1.00 (1.00-1.01)	12
Depression only								
Boys	1.03 (0.97-1.10)	1.00 (0.94-1.07)	1.03 (1.01-1.05)	100	1.04 (0.95-1.11)	1.01 (0.93-1.09)	1.03 (1.01-1.05)	74
Girls	1.09 (1.02-1.16)	1.06 (1.00-1.13)	1.03 (1.01-1.04)	29	1.04 (0.96-1.10)	1.02 (0.95-1.08)	1.02 (1.00-1.04)	53
LoC only								
Boys	1.05 (0.96-1.12)	1.04 (0.95-1.10)	1.01 (1.01-1.02)	29	1.04 (0.95-1.11)	1.03 (0.94-1.10)	1.01 (1.00-1.02)	25
Girls	1.07 (1.00-1.14)	1.05 (0.98-1.12)	1.02 (1.01-1.03)	26	1.03 (0.96-1.10)	1.01 (0.95-1.09)	1.02 (1.00-1.02)	50
Self-esteem only								
Boys	1.03 (0.95-1.12)	1.02 (0.94-1.10)	1.01 (1.00-1.02)	35	1.02 (0.94-1.11)	1.01 (0.93-1.10)	1.01 (1.00-1.02)	46
Girls	1.07 (1.00-1.13)	1.06 (0.98-1.12)	1.01 (1.00-1.02)	16	1.03 (0.95-1.10)	1.02 (0.94-1.09)	1.01 (1.00-1.02)	30

Domestic violence	Boys: N=2842	Girls: N=2939			Boys: N=2391	Girls: N=2513		
All mediators								
Boys	1.08 (0.99-1.17)	1.05 (0.97-1.14)	1.03 (1.01-1.04)	32	1.06 (0.97-1.14)	1.04 (0.95-1.12)	1.02 (1.00-1.03)	32
Girls	1.08 (1.00-1.16)	1.05 (0.98-1.13)	1.03 (1.01-1.04)	32	1.03 (0.96-1.11)	1.01 (0.94-1.08)	1.02 (1.01-1.04)	53
Anxiety only								
Boys	1.09 (1.02-1.16)	1.08 (1.01-1.15)	1.01 (1.00-1.02)	11	1.07 (0.99-1.15)	1.07 (0.99-1.14)	1.00 (1.00-1.01)	8
Girls	1.11 (1.04-1.17)	1.10 (1.03-1.16)	1.01 (1.00-1.02)	7	1.01 (0.94-1.09)	1.01 (0.94-1.09)	1.00 (1.00-1.01)	13
Depression only								
Boys	1.09 (1.02-1.15)	1.07 (1.01-1.14)	1.02 (1.00-1.03)	19	1.06 (0.98-1.14)	1.05 (0.97-1.12)	1.01 (1.00-1.02)	18
Girls	1.11 (1.05-1.17)	1.10 (1.04-1.16)	1.01 (1.00-1.02)	13	1.01 (0.93-1.07)	1.00 (0.93-1.07)	1.01 (1.00-1.01)	23
LoC only								
Boys	1.07 (0.99-1.15)	1.07 (0.99-1.14)	1.00 (1.00-1.01)	5	1.05 (0.98-1.13)	1.05 (0.98-1.13)	1.00 (0.99-1.00)	0
Girls	1.08 (1.02-1.15)	1.07 (1.01-1.14)	1.01 (1.00-1.02)	9	1.00 (0.91-1.07)	1.00 (0.91-1.07)	1.00 (0.99-1.01)	0
Self-esteem only								
Boys	1.06 (0.99-1.13)	1.05 (0.99-1.13)	1.01 (1.00-1.01)	10	1.05 (0.97-1.13)	1.05 (0.96-1.13)	1.00 (1.00-1.01)	6
Girls	1.11 (1.05-1.19)	1.11 (1.05-1.18)	1.00 (1.00-1.01)	4	1.02 (0.95-1.09)	1.02 (0.94-1.09)	1.00 (1.00-1.01)	17
Bullying	Boys: N=2490	Girls: N=2646			Boys: N=2237	Girls: N=2385		
All mediators								
Boys	1.14 (1.05-1.23)	1.09 (1.01-1.18)	1.05 (1.02-1.07)	33	1.11 (1.03-1.20)	1.08 (1.00-1.16)	1.03 (1.01-1.05)	31
Girls	1.14 (1.07-1.22)	1.09 (1.01-1.16)	1.05 (1.03-1.08)	38	1.13 (1.05-1.22)	1.09 (1.01-1.17)	1.04 (1.02-1.06)	32
Anxiety only								
Boys	1.13 (1.05-1.21)	1.13 (1.05-1.21)	1.00 (1.00-1.01)	2	1.11 (1.03-1.21)	1.11 (1.03-1.20)	1.00 (1.00-1.01)	0
Girls	1.15 (1.08-1.23)	1.15 (1.08-1.22)	1.00 (1.00-1.01)	2	1.15 (1.08-1.22)	1.15 (1.07-1.22)	1.00 (1.00-1.01)	1

Depression only								
Boys	1.15 (1.08-1.23)	1.14 (1.07-1.21)	1.11 (1.00-1.02)	10	1.12 (1.04-1.21)	1.11 (1.03-1.20)	1.01 (1.00-1.02)	10
Girls	1.16 (1.10-1.23)	1.15 (1.08-1.22)	1.01 (1.00-1.02)	7	1.15 (1.08-1.23)	1.14 (1.07-1.22)	1.01 (1.00-1.02)	5
LoC only								
Boys	1.15 (1.08-1.23)	1.12 (1.05-1.20)	1.03 (1.01-1.04)	17	1.13 (1.05-1.20)	1.11 (1.03-1.18)	1.02 (1.01-1.03)	14
Girls	1.15 (1.09-1.23)	1.12 (1.05-1.19)	1.03 (1.02-1.05)	21	1.15 (1.08-1.23)	1.13 (1.05-1.20)	1.02 (1.01-1.04)	16
Self-esteem only								
Boys	1.14 (1.07-1.21)	1.13 (1.05-1.20)	1.01 (1.00-1.02)	10	1.11 (1.04-1.19)	1.10 (1.02-1.18)	1.01 (1.00-1.02)	11
Girls	1.15 (1.09-1.22)	1.14 (1.08-1.20)	1.01 (1.00-1.02)	9	1.15 (1.09-1.23)	1.14 (1.07-1.21)	1.01 (1.00-1.02)	8

CI, confidence interval. LoC, locus of control. OR, odds ratio.

[a] Adjusted for ethnicity, birth weight, family psychiatric history, IQ and general family adversity.

Supplementary Table 2. Associations between different forms of victimization and *narrowly* defined psychotic symptoms, split into total effects, direct and indirect pathways via all of the potential mediators together and then via each individual mediator on its own, presented for boys and girls separately.

Type of victimization & potential mediator	Unadjusted				Adjusted[a]			
	Total OR (95% CI)	Direct OR (95% CI)	Indirect OR (95% CI)	% mediated	Total OR (95% CI)	Direct OR (95% CI)	Indirect OR (95% CI)	% mediated
Harsh parenting	*Boys: N=2524*	*Girls: N=2618*			*Boys: N=2189*	*Girls: N=2304*		
All mediators								
Boys	1.08 (0.92-1.22)	1.03 (0.89-1.16)	1.05 (1.02-1.08)	64	1.06 (0.90-1.20)	1.02 (0.87-1.14)	1.04 (1.01-1.07)	69
Girls	1.01 (0.91-1.12)	0.96 (0.85-1.06)	1.05 (1.02-1.09)	100	0.99 (0.86-1.10)	0.94 (0.83-1.05)	1.05 (1.01-1.08)	100
Anxiety only								
Boys	1.08 (0.96-1.20)	1.07 (0.95-1.19)	1.01 (1.00-1.02)	10	1.05 (0.92-1.18)	1.05 (0.92-1.17)	1.00 (1.00-1.01)	8
Girls	1.04 (0.95-1.14)	1.03 (0.93-1.13)	1.01 (1.00-1.03)	31	1.01 (0.90-1.12)	1.01 (0.90-1.12)	1.00 (0.99-1.01)	38
Depression only								
Boys	1.09 (0.99-1.20)	1.05 (0.95-1.16)	1.04 (1.01-1.06)	44	1.07 (0.94-1.18)	1.04 (0.91-1.14)	1.03 (1.01-1.06)	47
Girls	1.05 (0.96-1.14)	1.02 (0.92-1.11)	1.03 (1.01-1.06)	69	1.00 (0.91-1.12)	0.98 (0.88-1.09)	1.02 (1.00-1.05)	63
LoC only								
Boys	1.11 (0.98-1.23)	1.09 (0.97-1.21)	1.02 (1.00-1.03)	15	1.08 (0.96-1.19)	1.07 (0.94-1.17)	1.01 (1.00-1.03)	17
Girls	1.02 (0.93-1.14)	1.01 (0.92-1.12)	1.01 (1.00-1.03)	56	0.99 (0.88-1.08)	0.98 (0.88-1.08)	1.01 (1.00-1.02)	55
Self-esteem only								
Boys	1.05 (0.93-1.17)	1.04 (0.92-1.15)	1.01 (1.00-1.03)	23	1.03 (0.91-1.16)	1.02 (0.90-1.14)	1.01 (1.00-1.02)	35
Girls	1.03 (0.93-1.13)	1.02 (0.92-1.11)	1.01 (1.00-1.03)	45	1.00 (0.90-1.11)	0.98 (0.88-1.08)	1.02 (1.00-1.03)	58
Domestic violence	*Boys: N=2842*	*Girls: N=2938*			*Boys: N=2391*	*Girls: N=2512*		
All mediators								

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Boys	1.03 (0.90-1.16)	1.00 (0.88-1.13)	1.03 (1.01-1.05)	93	1.01 (0.88-1.15)	0.99 (0.85-1.12)	1.02 (1.00-1.04)	100
Girls	1.12 (1.01-1.22)	1.09 (0.98-1.18)	1.03 (1.00-1.05)	22	1.08 (0.97-1.21)	1.06 (0.96-1.19)	1.02 (1.00-1.04)	26
Anxiety only							
Boys	1.05 (0.95-1.16)	1.04 (0.93-1.15)	1.01 (1.00-1.02)	25	1.02 (0.90-1.16)	1.01 (0.89-1.16)	1.01 (1.00-1.01)	33
Girls	1.17 (1.07-1.26)	1.16 (1.06-1.24)	1.01 (1.00-1.02)	7	1.10 (0.99-1.21)	1.10 (0.99-1.21)	1.00 (1.00-1.01)	3
Depression only							
Boys	1.03 (0.94-1.14)	1.01 (0.91-1.11)	1.02 (1.01-1.04)	69	1.03 (0.86-1.13)	1.02 (0.87-1.12)	1.01 (0.98-1.02)	21
Girls	1.17 (1.08-1.26)	1.15 (1.07-1.24)	1.02 (1.00-1.03)	10	1.11 (1.00-1.22)	1.10 (1.00-1.22)	1.01 (1.00-1.02)	5
LoC only							
Boys	1.04 (0.91-1.16)	1.03 (0.91-1.15)	1.01 (1.00-1.01)	12	1.00 (0.87-1.11)	.99 (0.87-1.11)	1.00 (0.99-1.01)	9
Girls	1.13 (1.03-1.24)	1.13 (1.02-1.23)	1.00 (1.00-1.01)	5	1.07 (0.96-1.18)	1.07 (0.96-1.18)	1.00 (1.00-1.01)	2
Self-esteem only							
Boys	1.01 (0.90-1.11)	1.00 (0.90-1.11)	1.01 (1.00-1.01)	68	1.01 (0.89-1.15)	1.01 (0.88-1.14)	1.00 (0.98-1.03)	11
Girls	1.19 (1.09-1.27)	1.19 (1.09-1.27)	1.00 (1.00-1.01)	3	1.11 (0.99-1.23)	1.11 (0.99-1.23)	1.00 (1.00-1.01)	4
Bullying	*Boys: N=2497*	*Girls: N=2653*			*Boys: N=2237*	*Girls: N=2384*		
All mediators							
Boys	1.17 (1.03-1.32)	1.13 (0.98-1.28)	1.04 (1.01-1.07)	24	1.13 (0.98-1.31)	1.10 (0.95-1.27)	1.03 (1.00-1.05)	22
Girls	1.13 (1.00-1.24)	1.08 (0.95-1.18)	1.05 (1.02-1.08)	39	1.13 (1.00-1.26)	1.09 (0.96-1.22)	1.04 (1.01-1.07)	34
Anxiety only							
Boys	1.16 (1.03-1.29)	1.16 (1.03-1.29)	1.00 (1.00-1.01)	2	1.13 (1.02-1.27)	1.13 (1.01-1.27)	1.00 (1.00-1.01)	1
Girls	1.14 (1.02-1.25)	1.14 (1.02-1.25)	1.00 (1.00-1.01)	4	1.14 (1.02-1.27)	1.14 (1.02-1.26)	1.00 (1.00-1.01)	2
Depression only							
Boys	1.18 (1.07-1.30)	1.16 (1.05-1.28)	1.02 (1.00-1.03)	10	1.15 (1.05-1.28)	1.14 (1.03-1.27)	1.01 (1.00-1.02)	8

Girls	1.15 (1.05-1.26)	1.14 (1.04-1.24)	1.01 (1.00-1.03)	9	1.15 (1.03-1.27)	1.14 (1.02-1.25)	1.01 (1.00-1.02)	7
LoC only								
Boys	1.19 (1.06-1.31)	1.16 (1.03-1.28)	1.03 (1.01-1.05)	16	1.15 (1.04-1.28)	1.13 (1.02-1.26)	1.02 (1.01-1.04)	15
Girls	1.15 (1.05-1.25)	1.12 (1.02-1.23)	1.03 (1.01-1.04)	17	1.14 (1.03-1.27)	1.13 (1.01-1.24)	1.01 (1.00-1.03)	11
Self-esteem only								
Boys	1.19 (1.08-1.30)	1.18 (1.07-1.30)	1.01 (0.99-1.02)	4	1.15 (1.04-1.28)	1.14 (1.02-1.26)	1.01 (1.01-1.04)	5
Girls	1.14 (1.03-1.24)	1.12 (1.02-1.22)	1.02 (1.00-1.03)	13	1.13 (1.02-1.24)	1.11 (1.00-1.22)	1.02 (1.00-1.04)	15

CI, confidence interval. LoC, locus of control. OR, odds ratio.
[a] Adjusted for ethnicity, birth weight, family psychiatric history, IQ and general family adversity.