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3 Title: How much do parental ACEs tell us about child behaviour? Findings from the All Our Families  
4 longitudinal cohort  
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## Abstract:

Background: Growing interest in the impact of Adverse Childhood Experiences (ACEs) has led to research on understanding if ACEs experienced by parents may influence child behaviour. The objective of this study was to examine the association between maternal ACEs and child behaviour (internalizing and externalizing) at age 5 in the context of other factors.

Methods: Data from 1682 mothers and child dyads participating in the All Our Families cohort were used. Data were collected on factors related to the individual child (sex, age, temperament and behaviour), the mother (mental health, personality and parenting) and socio-demographics (family income, ethnicity and family structure) when children were ages 3 and 5. Logistic regression models estimated crude and adjusted associations between maternal ACEs and child externalizing and internalizing behaviours.

Results: In crude models, maternal ACEs (4+) were associated with child externalizing and internalizing behaviours at age 5. However, when adjusted for other proximal factors, these associations decreased and other proximal risk factors had stronger associations with outcomes. Persistent maternal mental health symptoms were associated with both externalizing and internalizing behaviours at age 5 (AOR: 4.14, 95% CI 2.46, 6.96, AOR: 2.49, 95% CI 1.64, 3.77). High levels of ineffective parenting behaviours were associated with both child behaviour outcomes (AOR: 6.33, 95% CI 4.34, 9.24; AOR: 1.42, 95% CI 1.02, 1.97).

Interpretation: Focusing on more proximal factors, such as parental mental health and parenting behaviours may be a more influential and less stigmatizing way of identifying children at risk of behavioural problems at age 5.

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3 Introduction:

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6 Since the publication of the landmark Adverse Childhood Experiences (ACEs) study in 1998 by Felitti and  
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8 colleagues, there has been growing evidence about how experiences of abuse, neglect, and household  
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10 dysfunction in childhood relate to health outcomes over the life course.(1-5) Recently, researchers have  
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12 begun to investigate whether ACEs may have intergenerational effects. For example, a retrospective  
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14 study of 500 families in Oregon found that parental ACEs were associated with increased risk for  
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16 suspected developmental delay in 2 year old children.(5) Additional evidence from larger studies  
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18 suggests that maternal adversity is associated with children's increased behavioural challenges including  
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20 hyperactivity and conduct problems.(6, 7) Given the demonstrated influence of parental adversity on  
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22 child outcomes, the practice of screening for parental ACEs by pediatricians has gained momentum in  
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24 order to identify children who may be at risk for poor developmental outcomes.(8) However, the  
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26 intergenerational influence of parental ACEs on child behaviour and development is complex, and  
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28 research to date has not adequately addressed whether asking about other psychosocial risk factors  
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30 may be a more effective and potentially less stigmatizing approach to identifying families at risk.(9, 10)  
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32 For example, parent mental health and parenting behaviours are more proximal to the child than the  
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34 parent's past childhood experiences, and therefore, they may have a more substantial association on  
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36 child functioning. Thus, understanding the association between parental ACEs and child behaviour in the  
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38 context of other individual, family, and community factors, is important in order to provide clarity on  
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40 where physicians should focus their efforts in the context of pediatric visits.  
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47 Ecological systems theory suggests that child development is influenced by factors at various levels,  
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49 including those unique to the child, to the family, and to the broader socio-environmental context.(11)  
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51 At the child level, male sex has been consistently associated with externalizing behaviours in children,  
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53 including hyperactivity and physical aggression.(12-14) Conversely, internalizing behaviours, including  
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55 anxiety and depression, are more commonly found in females.(15, 16) Child temperament, particularly  
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3 negative affect, has been associated with both externalizing and internalizing behaviours in young  
4 children.(17-19) At the family level maternal mental health and personality (particularly neuroticism)  
5 and parenting have been consistently linked to child behaviour. (13, 14, 20-23) At the broader social  
6 level, children from families with higher levels of chaos, or lower levels of income, tend to exhibit more  
7 behavioural challenges.(24-27) The objective of this study is to examine the association between  
8 maternal ACEs and child behaviour difficulties in the context of individual, family, and community risk  
9 factors including child sex and temperament, maternal mental health and affect, parenting style, family  
10 income and composition. Specifically, we examined the role of these factors on child internalizing (e.g.,  
11 anxiety and depression) and externalizing difficulties (e.g., aggression and hyperactivity) problems at age  
12 5, which tend to be precursors for psychopathology in later childhood.(27) This study received ethical  
13 approval from the University of Calgary.

#### 31 Methods:

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34 *Participants:* Data from women and children who participated the All Our Families Cohort were used,  
35 details are described elsewhere.(28, 29) Briefly, women were recruited from a community sample  
36 during pregnancy between 2008 and 2010 and followed longitudinally. To be eligible, women had to be  
37 18 or older, understand English, and live in Calgary. At each data collection timepoint, eligible women  
38 mailed a questionnaire with a prepaid return envelope and were contacted by telephone and email to  
39 provide additional opportunities to respond or resolve unclear responses. Data was collected on a wide  
40 variety of socio-demographic, maternal mental and physical health and child development. To be  
41 eligible for the current analysis, women had to have completed the child behaviour questions at the 5-  
42 year follow-up (1992/2845=71% response rate) and completed information on maternal ACEs at the 3  
43 year follow-up (1994/2909=69% response rate), resulting in a sample size of 1682.

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3 *Outcome variables:* Child externalizing and internalizing behaviours at 5 years were measured using the  
4 Behavioral Assessment System for Children -2 (BASC-2).(30) Parents are asked 124 questions about their  
5 child's behaviour on a 4-point Likert scale. Scores are standardized (mean 50, sd. 10) and compared to a  
6 normed reference population. Children who score 60 or above are considered to be at risk for the  
7 outcome. The BASC-2 contains a wide number of subscales including two composite scales for  
8 measuring internalizing behaviours (anxiety, depression and somatization) and externalizing behaviours  
9 (hyperactivity and aggression).

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19 *Primary exposure variable:* Maternal ACEs were measured by asking 11 questions modified from the  
20 original ACE checklist.(31) Mothers were asked about childhood experiences of physical, verbal and  
21 sexual abuse as household disfunction. See supplementary file 2 for specific questions. Women who  
22 experienced 4 or more ACEs were considered to have a "high ACE score" compared to 3 or fewer,  
23 consistent with previous studies.(1)

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31 *Other variables:* Other factors known to be associated with child behavioural outcomes were included  
32 based on the literature, and on ecological systems theory described above. In the current study, factors  
33 unique to the child included child age, sex and temperament. Questionnaires were provided to mothers  
34 shortly after their child's 5<sup>th</sup> birthday, and age at survey completion was measured in months. Child  
35 temperament was measured at age 3 using the negative affect subscale of the Rothbart Child  
36 Temperament Scale Very Short Form. Parents rate their child's reactions to 12 situations about anger,  
37 sadness and fear on a 7 point Likert scale, Cronbach's alpha for this sample is 0.69.(32)

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48 At the family level, variables included maternal mental health, maternal neuroticism and parenting  
49 behaviour. As mental health conditions are often comorbid, and can be either persistent or periodic,  
50 mental health was operationalized as having depressive or anxiety symptoms when the child was 3  
51 years of age, 5 years of age, both or neither.(33) Anxiety was measured using the Spielberger State  
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3 Anxiety Inventory (SSAI)(34). The 20 item-version of the scale was used at 3 years, and a score of 40 or  
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5 higher is considered to be clinically significant. A shortened 6-item version was used at 5 years, which  
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7 has been shown to have good validity and reliability in our sample.(35) Depressive symptoms were  
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9 measured using the Center for Epidemiologic Studies – Depression Scale (CES-D), with a score of 16 or  
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11 above considered clinically significant.(36)  
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15 Maternal neuroticism was measured using the 12-item Eysenck Personality Questionnaire Revised Short  
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17 Scale (EPQR).(37) Higher scores correspond to higher levels of neuroticism and lower emotional stability  
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19 with a Cronbach’s alpha in this sample of 0.81. Parenting behaviour was measured using the  
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21 ineffective/hostile parenting subscale of the National Longitudinal Survey of Children and Youth when  
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23 children were 5 years of age (see supplementary file for a list of questions).(38) On a 5 point Likert  
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25 scale, parents are asked questions about the frequency of a set of parenting behaviours including  
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27 negative reinforcement, repeated discipline for the same issue, and disciplining a child when angry. The  
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29 Cronbach’s alpha in this sample of 0.78.  
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33 Factors at the broader social level included family income, ethnicity, and family composition. Family  
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35 income was reported in Canadian Dollars in 10,000 increments starting at 30,000 CAD and in 25,000 CAD  
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37 over 100,000 CAD to 200,000 CAD. Because cultural background may impact parenting styles and  
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39 reporting around child behaviour, ethnicity was categorized as self-reported white and self-reported  
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41 minority. Finally, family composition was reported as “two parent family with both biological parents”,  
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43 “two parent family with one biological parent”, “single parent”, or “other”. These were collapsed to  
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45 “two parent family with both biological parents” and “single or blended family” to capture family  
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47 structure. Families who chose “other” (n=27) were categorized into the two categories according to the  
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49 description they provided.  
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54 *Analysis:*  
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3 Logistic regression models were run to estimate the association between maternal ACEs and child  
4 externalizing and internalizing behaviours. Models estimate crude associations, and associations  
5 adjusted for all other variables described. Among those with completed questionnaires (n=1682), there  
6 were fewer than 2% missing data on any given variable, so complete case analysis was used. For  
7 consistency and ease of interpretation, all scales without clinical cut points were dichotomized at 1  
8 standard deviation above or below the mean as appropriate. To confirm that dichotomization of  
9 covariates did not oversimplify associations, all models were confirmed with continuous variables in  
10 supplementary sensitivity analysis. All analyses were carried out using STATA IC v.15.  
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## 25 Results

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27 Sample characteristics can be found in Table 1. Approximately 10% of children had elevated or clinical  
28 levels of externalizing behaviours, and 16% for internalizing behaviours (score of 60 or above). Fourteen  
29 percent of mothers in the sample reported 4 or more ACEs. Children had a mean age of 61 months (5  
30 years), and slightly over half were boys. Approximately 70% of mothers had no mental health symptoms  
31 at 3 or 5 years, and between 8 and 12 percent had depression and/or anxiety symptoms at 3 years, 5  
32 years, or both. Just under 20% of mothers reported using high levels of ineffective/hostile parenting  
33 practices. Of the families included, 17.5% self-identified as minority ethnicity, and 6% were single parent  
34 or blended family home.  
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46 [Insert Table 1 here]  
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49 Unadjusted (crude) and adjusted odds ratios for the association between maternal ACEs and  
50 externalizing and internalizing behaviours at age 5 are shown in Table 2. Crude models show a  
51 statistically significant association between maternal ACEs and child behaviour at age 5. However, in the  
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3 adjusted models, the association with maternal ACEs decreases, and becomes non-significant at the 0.05  
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5 level for internalizing behaviour.  
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8 Among other child level covariates, high levels of negative child affect is associated with a two fold  
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10 increased odds of both externalizing and internalizing behaviours(AOR: 2.42 95% CI 1.59, 3.67 & AOR  
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12 2.44 95% CI 1.77, 3.36), and male sex is associated with an almost 3 times increased odds of  
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14 externalizing behaviours only (AOR 2.89 95% CI 1.92, 4.34). Among maternal covariates, current or  
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16 persistent mental health symptoms is associated with both externalizing and internalizing behaviours at  
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18 age 5, while high levels of maternal neuroticism is associated with internalizing only (AOR 2.22, 95% CI  
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20 1.54, 3.20). High levels of ineffective/hostile parenting behaviours is associated with a 6.33 increased  
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22 odds of externalizing behaviours (95% CI 4.34, 9.24). These parenting behaviours are also associated  
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24 with internalizing behaviours in children at age 5, but at a lower level (AOR: 1.42, 95% CI 1.02, 1.97).  
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26 Other social variables have marginal associations on child behaviour at age 5. Sensitivity analysis  
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28 showing these associations using variables as continuous measures are consistent with these findings  
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30 and can be seen in the supplementary file 2.  
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36 [Insert Table 2 here]  
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### 39 Interpretation

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41 The results from this analysis show a modest association between maternal ACEs and child behaviour at  
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43 5 years, which is reduced when adjusting for other factors at the child, family and community levels.  
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45 Specifically, proximal factors including child affect in early childhood, parenting practices, and parent  
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47 mental health are more strongly associated with the children's risk of externalizing and/or internalizing  
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49 behaviours at age 5. Routine screening of parental ACEs without consideration for other psychosocial  
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51 risk factors may provide an incomplete understanding of children who are at risk of behaviour  
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53 difficulties. Assessment and identification of proximal factors, namely those specific to the individual  
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3 child and their parents' current well-being, may more accurately characterize families most in need of  
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5 support.  
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8 Our results showed that there was no association between maternal ACEs and child internalizing  
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10 behaviours at age 5 when other known risk factors were adjusted for. However, the adjusted association  
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12 between maternal ACEs and externalizing behaviours was statistically significant (AOR 1.96, 95%CI, 1.24,  
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14 3.10). Our results are consistent with other findings that the influence of maternal ACEs on child  
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16 outcomes is relatively small compared to other factors.(39, 40) For example, research from the AVON  
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18 longitudinal study of parents and children suggested that the association between maternal ACEs and  
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20 conduct problems, hyperactivity and other child behaviour was fully mediated by more proximal  
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22 influences of child trauma and changes in family structure.(6)  
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26 Our study is consistent with longitudinal and cross-sectional research that shows that high levels of  
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28 ineffective/hostile parenting practices are associated with child behaviour problems.(23, 41) In this  
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30 study, high levels of ineffective/hostile parenting was associated with a 6.33 increased odds of  
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32 externalizing behaviours at age 5 (95% CI 4.34, 9.24). We cannot infer causality from these observational  
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34 data, however, this association is robust, and suggests that parenting, particularly hostile parenting  
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36 behaviour, is a strong indicator of child behaviour problems. There are many low cost, effective,  
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38 community based interventions to improve parenting practices, parental mental health, and child  
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40 behaviour.(42, 43) Given the magnitude of this association compared to the association with parental  
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42 ACEs, physicians may find it more efficient to discuss parenting strategies than parental ACEs, which can  
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44 be found in a recent CPS statement.(44)  
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48 In our study, maternal mental health, both current and persistent, was associated with up to 4.14  
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50 increased odds in externalizing behaviours at age 5 (95% CI 2.46, 6.96), and a 2.49 increased odds of  
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52 internalizing behaviours at age 5 (95% CI 1.64, 3.77). This is consistent with other research suggesting  
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3 maternal depression is associated with increased hyperactive behaviours at age 6, and a recent meta-  
4 analysis which found that both parental depression and anxiety were associated with social-emotional  
5 problems in children.(13, 21) Screening tools for depression and anxiety are widely available, and can  
6 result in more efficiencies in service utilization.(45-47) Thus, assessment of parent mental health may be  
7 more informative than asking about parent childhood trauma. Furthermore, the acceptability and  
8 appropriateness of the ACEs questionnaire as a screening tool remains controversial.(48, 49) Pilot  
9 studies for ACEs screening have low participation rates of 50% or less, and consequently should be  
10 interpreted with caution.(8, 50-52) Furthermore, work by Cronholm et al. and Finkelhor et al. suggests  
11 that the original ACE questions miss important types of adversity including peer isolation/victimization,  
12 exposure to community violence, living in foster care and/or poverty, all of which have important  
13 physical and mental health consequences.(53, 54) Given the relative magnitude of the association  
14 between maternal mental health and child behaviour compared to that of maternal ACES and child  
15 behaviour, physicians may wish to focus on parental mental health as a better indicator of risk for poor  
16 child behaviour outcomes.

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19 This study has several limitations, including the absence of measures of fathers' mental health,  
20 personality or parenting. In addition, mothers reported their own mental health, personality and  
21 parenting as well as the behaviour and temperament of their children. This could lead to reporting bias,  
22 for example mothers with mental health challenges may be more likely to report child behavioural  
23 problems.(55) Our study is strengthened by the large sample size, and high response rates over time.  
24 Some differential attrition has occurred among specific groups (lower income, and minority ethnicity)  
25 which might minimally bias associations towards the null.(29) These results may be considered broadly  
26 generalizable to a typical pediatric or family medicine setting, but may not be applicable to higher risk  
27 groups.

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3 The aim of our study was to understand whether parental ACEs were associated with child behaviour  
4 difficulties when individual, parent, and social factors were considered. Our results indicate that parent  
5 mental health and parenting behaviour may be more optimal targets for assessment and intervention  
6 within the pediatric setting than parent ACEs. Physicians are a respected source of information on child  
7 development and may be the first source of contact for concerns around child behaviour difficulties.(56)  
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14 Considering the busy nature of pediatric visits, physicians can be reassured that information on the  
15 proximal and relevant risk factors, such as child affect, parent mental health and parenting practices, will  
16 identify those most at risk for child behaviour problems.  
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Confidential

## References:

1. Felitti VJ, Anda RF, Nordenberg D, Williamson DF, Spitz AM, Edwards V, et al. Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults: The Adverse Childhood Experiences (ACE) Study. *American journal of preventive medicine*. 1998;14(4):245-58.
2. Anda RF, Felitti VJ, Bremner JD, Walker JD, Whitfield C, Perry BD, et al. The enduring effects of abuse and related adverse experiences in childhood. *European archives of psychiatry and clinical neuroscience*. 2006;256(3):174-86.
3. Shonkoff JP, Garner AS, Siegel BS, Dobbins MI, Earls MF, McGuinn L, et al. The lifelong effects of early childhood adversity and toxic stress. *Pediatrics*. 2012;129(1):e232-e46.
4. Kalmakis KA, Chandler GE. Health consequences of adverse childhood experiences: a systematic review. *Journal of the American Association of Nurse Practitioners*. 2015;27(8):457-65.
5. Folger AT, Eismann EA, Stephenson NB, Shapiro RA, Macaluso M, Brownrigg ME, et al. Parental adverse childhood experiences and offspring development at 2 years of age. *Pediatrics*. 2018;141(4):e20172826.
6. Collishaw S, Dunn J, O'connor TG, Golding J, Parents ALSo, Team CS. Maternal childhood abuse and offspring adjustment over time. *Development and psychopathology*. 2007;19(2):367-83.
7. McDonald S, Madigan S, Racine N, Benzies K, Tomfohr L, Tough S. Maternal adverse childhood experiences, mental health, and child behaviour at age 3: The all our families community cohort study. *Preventive medicine*. 2019;118:286-94.
8. Gillespie R, Folger AT. Feasibility of assessing parental ACEs in pediatric primary care: implications for practice-based implementation. *Journal of Child & Adolescent Trauma*. 2017;10(3):249-56.
9. Bair-Merritt MH, Zuckerman B. Exploring Parents' Adversities in Pediatric Primary Care Parental Adversities in Pediatric Primary Care. *JAMA Pediatrics*. 2016;170(4):313-4.
10. Christakis DA. Focusing on the smaller adverse childhood experiences: The overlooked importance of aces. *JAMA pediatrics*. 2016;170(8):725-6.
11. Bronfenbrenner U. Ecological systems theory (1992). In: Bronfenbrenner U, editor. *Making human beings human: Bioecological perspectives on human development* Thousand Oaks, CA: Sage Publications; 2005. p. 106-73.
12. Entwisle DR, Alexander KL, Olson LS. Early schooling: The handicap of being poor and male. *Sociology of Education*. 2007;80(2):114-38.
13. Romano E, Tremblay RE, Farhat A, Côté S. Development and prediction of hyperactive symptoms from 2 to 7 years in a population-based sample. *Pediatrics*. 2006;117(6):2101-10.
14. Hetherington E, McDonald S, Racine N, Tough S. Risk and Protective Factors for Externalizing Behavior at Three Years: Results from the All Our Families (AOF) pregnancy cohort. *Journal of Developmental and Behavioural Pediatrics*. 2018.
15. Liu J, Chen X, Lewis G. Childhood internalizing behaviour: analysis and implications. *Journal of Psychiatric and Mental Health Nursing*. 2011;18(10):884-94.
16. Keiley MK, Bates JE, Dodge KA, Pettit GS. A cross-domain growth analysis: Externalizing and internalizing behaviors during 8 years of childhood. *Journal of abnormal child psychology*. 2000;28(2):161-79.
17. Eisenberg N, Valiente C, Spinrad TL, Cumberland A, Liew J, Reiser M, et al. Longitudinal relations of children's effortful control, impulsivity, and negative emotionality to their externalizing, internalizing, and co-occurring behavior problems. *Developmental psychology*. 2009;45(4):988.

18. Crawford NA, Schrock M, Woodruff-Borden J. Child internalizing symptoms: Contributions of child temperament, maternal negative affect, and family functioning. *Child Psychiatry & Human Development*. 2011;42(1):53-64.
19. Hentges RF, Graham SA, Plamondon A, Tough S, Madigan S. A developmental cascade from prenatal stress to child internalizing and externalizing problems. *Journal of pediatric psychology*. 2019.
20. Tremblay RE, Nagin DS, Séguin JR, Zoccolillo M, Zelazo PD, Boivin M, et al. Physical aggression during early childhood: Trajectories and predictors. *Pediatrics*. 2004;114(1):e43-e50.
21. Madigan S, Oatley H, Racine N, Fearon RP, Schumacher L, Akbari E, et al. A meta-analysis of maternal prenatal depression and anxiety on child socio-emotional development. *Journal of the American Academy of Child & Adolescent Psychiatry*. 2018.
22. Côté S, Vaillancourt T, LeBlanc JC, Nagin DS, Tremblay RE. The development of physical aggression from toddlerhood to pre-adolescence: A nation wide longitudinal study of Canadian children. *Journal of abnormal child psychology*. 2006;34(1):68-82.
23. Browne DT, Oduyungbo A, Thabane L, Byrne C, Smart LA. Parenting-by-gender interactions in child psychopathology: attempting to address inconsistencies with a Canadian national database. *Child and Adolescent Psychiatry and Mental Health*. 2010;4(1):5.
24. Hardaway CR, Wilson MN, Shaw DS, Dishion TJ. Family Functioning and Externalizing Behaviour among Low-income Children: Self-regulation as a Mediator. *Infant Child Dev*. 2012;21(1):67-84.
25. Coldwell J, Pike A, Dunn J. Household chaos--links with parenting and child behaviour. *J Child Psychol Psychiatry*. 2006;47(11):1116-22.
26. Evans GW, Kim P. Childhood poverty, chronic stress, self-regulation, and coping. *Child development perspectives*. 2013;7(1):43-8.
27. Mesman J, Koot HM. Early preschool predictors of preadolescent internalizing and externalizing DSM-IV diagnoses. *Journal of the American Academy of Child & Adolescent Psychiatry*. 2001;40(9):1029-36.
28. McDonald SW, Lyon AW, Benzies KM, McNeil DA, Lye SJ, Dolan SM, et al. The All Our Babies pregnancy cohort: design, methods, and participant characteristics. *BMC Pregnancy Childbirth*. 2013;13.
29. Tough SC, McDonald SW, Collisson BA, Graham SA, Kehler H, Kingston D, et al. Cohort Profile: The All Our Babies pregnancy cohort (AOB). *International Journal of Epidemiology*. 2017;46(5):1389-90k.
30. Kamphaus R. Behavior Assessment System for Children, (BASC-2). *The Encyclopedia of Clinical Psychology*. 2014:1-6.
31. Prevention CfDca. Behavioral Risk Factor Surveillance System Adverse Childhood Experience (ACE) Module 2009 [
32. Putnam SP, Rothbart MK. Development of short and very short forms of the Children's Behavior Questionnaire. *Journal of personality assessment*. 2006;87(1):102-12.
33. Hetherington E, McDonald S, Williamson T, Patten SB, Tough SC. Social support and maternal mental health at 4 months and 1 year postpartum: analysis from the All Our Families cohort. *Journal of Epidemiology & Community Health*. 2018;jech-2017-210274.
34. Spielberger C, R G. Test Manual for the State-Trait Anxiety Inventory. Palo Alto, California: Consulting Psychologist's Press; 1970.
35. Bayrampour H, McDonald S, Fung T, Tough S. Reliability and validity of three shortened versions of the State Anxiety Inventory scale during the perinatal period. *Journal of Psychosomatic Obstetrics & Gynecology*. 2014;35(3):101-7.
36. Radloff LS. The CES-D scale: A self-report depression scale for research in the general population. *Applied psychological measurement*. 1977;1(3):385-401.
37. Eysenck SB, Eysenck HJ, Barrett P. A revised version of the psychoticism scale. *Personality and individual differences*. 1985;6(1):21-9.

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- 3
- 4 38. Statistics Canada. National Longitudinal Survey of Children and Youth (NLSCY), Cycle 4 -
- 5 Microdata User Guide. Ottawa: Statistics Canada; 2001.
- 6 39. Racine NM, Madigan SL, Plamondon AR, McDonald SW, Tough SC. Differential associations of
- 7 adverse childhood experience on maternal health. *American journal of preventive medicine*.
- 8 2018;54(3):368-75.
- 9 40. Steele H, Bate J, Steele M, Dube SR, Danskin K, Knafo H, et al. Adverse childhood experiences,
- 10 poverty, and parenting stress. *Canadian Journal of Behavioural Science/Revue canadienne des sciences*
- 11 *du comportement*. 2016;48(1):32.
- 12 41. Hetherington E, McDonald S, Racine N, Tough S. Longitudinal Predictors of Self-Regulation at age
- 13 5. 2019.
- 14 42. Perrin EC, Sheldrick RC, McMenemy JM, Henson BS, Carter AS. Improving parenting skills for
- 15 families of young children in pediatric settings: A randomized clinical trial. *JAMA pediatrics*.
- 16 2014;168(1):16-24.
- 17 43. Furlong M, McGilloway S, Bywater T, Hutchings J, Smith SM, Donnelly M. Behavioural and
- 18 cognitive-behavioural group-based parenting programmes for early-onset conduct problems in children
- 19 aged 3 to 12 years. *Cochrane Database of Systematic Reviews*. 2012(2).
- 20 44. Williams RC, Biscaro A, Clinton J. Relationships matter: How clinicians can support positive
- 21 parenting in the early years. *Paediatrics & Child Health*. 2019;24(5):340-7.
- 22 45. Kingston D, McDonald S, Tough S, Austin M-P, Hegadoren K, Lasiuk G. Public views of
- 23 acceptability of perinatal mental health screening and treatment preference: a population based survey.
- 24 *BMC Pregnancy Childbirth*. 2014;14(1):67.
- 25 46. Premji S, McDonald SW, Metcalfe A, Faris P, Quan H, Tough S, et al. Examining postpartum
- 26 depression screening effectiveness in well child clinics in Alberta, Canada: A study using the All Our
- 27 Families cohort and administrative data. *Preventive medicine reports*. 2019;14:100888.
- 28 47. Rafferty J, Mattson G, Earls MF, Yogman MW, Child CoPAo, Health F. Incorporating recognition
- 29 and management of perinatal depression into pediatric practice. *Pediatrics*. 2019;143(1):e20183260.
- 30 48. Finkelhor D. Screening for adverse childhood experiences (ACEs): Cautions and suggestions.
- 31 *Child abuse & neglect*. 2018;85:174-9.
- 32 49. McLennan JD, MacMillan HL, Afifi TO, McTavish J, Gonzalez A, Waddell C. Routine ACEs
- 33 screening is NOT recommended. *Paediatrics & Child Health*. 2019.
- 34 50. Conn A-M, Szilagyi MA, Jee SH, Manly JT, Briggs R, Szilagyi PG. Parental perspectives of screening
- 35 for adverse childhood experiences in pediatric primary care. *Families, Systems, & Health*. 2018;36(1):62.
- 36 51. Planey B. Aces and state maternal child health programs. *Academic pediatrics*. 2017;17(7):S30-
- 37 S1.
- 38 52. Selvaraj K, Ruiz MJ, Aschkenasy J, Chang JD, Heard A, Minier M, et al. Screening for Toxic Stress
- 39 Risk Factors at Well-Child Visits: The Addressing Social Key Questions for Health Study. 2019.
- 40 53. Cronholm PF, Forke CM, Wade R, Bair-Merritt MH, Davis M, Harkins-Schwarz M, et al. Adverse
- 41 childhood experiences: expanding the concept of adversity. *American Journal of Preventive Medicine*.
- 42 2015;49(3):354-61.
- 43 54. Finkelhor D, Shattuck A, Turner H, Hamby S. A revised inventory of adverse childhood
- 44 experiences. *Child abuse & neglect*. 2015;48:13-21.
- 45 55. Durbin CE, Wilson S. Convergent validity of and bias in maternal reports of child emotion.
- 46 *Psychological assessment*. 2012;24(3):647.
- 47 56. Taylor CA, Moeller W, Hamvas L, Rice JC. Parents' professional sources of advice regarding child
- 48 discipline and their use of corporal punishment. *Clinical Pediatrics*. 2013;52(2):147-55.
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Table 1: Sample Characteristics

	n	% *
Externalizing Behaviours	158	9.5%
Internalizing Behaviours	273	16.4%
Maternal ACEs (4+)	231	13.7%
<b>Child covariates</b>		
Child age in months (mean, sd)	61.6	3.1
Male sex	886	52.9%
Negative affect ( $\geq 1$ sd RCBQ)	277	16.5%
<b>Maternal Covariates</b>		
No mental health symptoms	1142	69.4%
Depression or anxiety at 3 years only	136	8.3%
Depression or anxiety at 5 years only	200	12.2%
Depression or anxiety at 3 & 5 years	168	10.2%
High maternal neuroticism ( $\geq 1$ sd EPQR)	260	15.5%
High ineffective/hostile parenting ( $\geq 1$ sd NLSCY) @ 5 yrs	311	18.8%
<b>Socio-demographic covariates</b>		
Family income		
$\leq 60,000$ CAD	142	8.6%
60,000 - $\leq 100,000$ CAD	376	22.7%
100,000 - $\leq 150,000$ CAD	506	30.6%
150,000 CAD +	631	38.1%
Minority ethnicity	295	17.5%
Single parent or blended family	107	6.4%

\*Some variation in the denominator due to minimal missing data (less than 3% missing data on any given variable)

ACEs: Adverse Childhood Experiences, EPQR: Eysenck Personality Questionnaire Revised, NLSCY: National Longitudinal Survey of Children and YOUTH, CAD: Canadian Dollar

Table 2: Crude and adjusted Odds Ratios for the association between maternal ACEs and externalizing and internalizing behaviour at age 5

	Externalizing Behaviour @ 5 yrs			Internalizing Behaviour @ 5 yrs		
	OR	95% CI	p-value	OR	95% CI	p-value
<b>Crude model</b>						
Maternal ACEs (4+)	2.59	(1.63, 3.23)	<0.001	1.58	(1.12, 2.23)	0.009
<b>Adjusted model</b>						
Maternal ACEs (4+)	1.96	(1.24, 3.10)	0.004	1.19	(0.81, 1.73)	0.372
<b>Child covariates</b>						
Child age in months (mean, sd)	1.02	(0.96, 1.08)	0.514	1.02	(0.98, 1.07)	0.287
Male sex	2.89	(1.92, 4.34)	<0.001	0.83	(0.63, 1.10)	0.190
Negative affect ( $\geq 1$ sd RCBQ)	2.42	(1.59, 3.67)	<0.001	2.44	(1.77, 3.36)	<0.001
<b>Maternal Covariates</b>						
No mental health symptoms (baseline)						
Depression or anxiety at 3 years only	1.54	(0.78, 3.05)	0.212	0.97	(0.57, 1.65)	0.902
Depression or anxiety at 5 years only	2.13	(1.27, 3.57)	0.004	1.87	(1.26, 2.78)	0.002
Depression or anxiety at 3 & 5 years	4.14	(2.46, 6.96)	<0.001	2.49	(1.64, 3.77)	<0.001
High maternal neuroticism ( $\geq 1$ sd EPQR)	0.97	(0.60, 1.58)	0.902	2.22	(1.54, 3.20)	<0.001
High ineffective/hostile parenting ( $\geq 1$ sd NLSY) @ 5 yrs	6.33	(4.34, 9.24)	<0.001	1.42	(1.02, 1.97)	0.039
<b>Socio-demographic covariates</b>						
Family income (increasing)	0.94	(0.87, 1.00)	0.061	0.97	(0.92, 1.03)	0.335
Minority ethnicity	0.86	(0.52, 1.40)	0.539	1.55	(1.10, 2.18)	0.012
Single parent or blended home	1.09	(0.54, 2.20)	0.811	1.15	(0.66, 2.00)	0.619

ACEs: Adverse Childhood Experiences; AOR: Adjusted Odds Ratio; CI: Confidence Interval; EPQR: Eysenck Personality Questionnaire Revised; OR: Odds Ratio; NLSY: National Longitudinal Survey of Children and YOUTH, CAD: Canadian Dollar

## Supplementary file 1:

## Adverse Childhood Experiences Questions

The following questions are about events that happened during YOUR childhood; that is, before 18 years of age.

This widely used tool asks about sensitive topics. Some people may feel uncomfortable with these questions.

	Yes	No
Did you live with anyone who was depressed, mentally ill, or suicidal?	<input type="radio"/>	<input type="radio"/>
Did you live with anyone who was a problem drinker or alcoholic?	<input type="radio"/>	<input type="radio"/>
Did you live with anyone who used illegal street drugs or who abused prescription medications?	<input type="radio"/>	<input type="radio"/>
Did you live with anyone who served time or was sentenced to serve time in prison, jail or other correctional facility?	<input type="radio"/>	<input type="radio"/>
Were your parents separated or divorced?	<input type="radio"/>	<input type="radio"/>

	Never	Once	More than once
How often did your parents or adults in your household ever slap, hit, kick, punch or beat each other up?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Before age 18, how often did a parent or adult in your home ever hit, beat, kick, or physically hurt you in any way? (Please do not include spanking)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How often did a parent or adult in your home ever swear at you, insult you, or put you down?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How often did anyone at least 5 years older than you or an adult ever touch you sexually?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How often did anyone at least 5 years older than you or an adult try to make you touch them sexually?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How often did anyone at least 5 years older than you or an adult force you to have sex?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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2  
3 Ineffective/hostile parenting questions  
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5 The following questions have to do with things that your child does and ways that you, as a parent, react to  
6 him/her.  
7

	Never	About once a week or less	A few times a week	One or two times a day	Many times each day
8 9 10 11 12 How often do you get annoyed with this child for saying or doing something he/she is not supposed to do?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Never	Less than half the time	About half the time	More than half the time	All the time
13 14 15 16 17 Of all the times that you talk to him/her about his/her behaviour, what proportion is praise?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
18 19 20 21 Of all the times that you talk to him/her about his/her behaviour, what proportion is disapproval?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
22 23 24 25 How often do you get angry when you punish him/her?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
26 27 28 29 How often do you think that the kind of punishment you give him/her depends on your mood?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
30 31 32 33 How often do you feel you are having problems with managing him/her in general?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 How often do you have to discipline him/her repeatedly for the same thing?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## Supplementary file 2: Logistic regression with ACEs and other covariates measured continuously.

	Externalizing Behavior			Internalizing Behavior		
	AOR	95% CI	p-value	AOR	95% CI	p-value
Maternal ACEs (+1 ACE)	1.19	(1.08, 1.32)	0.001	1.02	(0.94, 1.10)	0.68
<b>Child factors</b>						
Child age in months	1.02	(0.96, 1.09)	0.576	1.03	(0.98, 1.08)	0.242
Male sex	2.80	(1.84, 4.27)	0.000	0.82	(0.62, 1.09)	0.177
Negative affect (RCBQ)	1.54	(1.21, 1.97)	0.001	2.04	(1.67, 2.48)	0
<b>Maternal factors</b>						
Anxiety symptoms at 5 years	1.10	(1.02, 1.18)	0.012	1.02	(0.96, 1.07)	0.589
Depression symptoms at 5 years	1.01	(0.97, 1.04)	0.589	1.03	(1.01, 1.05)	0.005
Maternal neuroticism (EPQR)	1.00	(0.93, 1.07)	0.998	1.10	(1.05, 1.16)	0
Ineffective/hostile parenting (NLSCY)	1.32	(1.25, 1.39)	0.000	1.07	(1.03, 1.11)	0.001
<b>Socio-environmental factors</b>						
Family income (increasing)	0.92	(0.86, 0.99)	0.035	0.98	(0.92, 1.03)	0.525
Minority ethnicity	0.89	(0.53, 1.51)	0.674	1.54	(1.08, 2.19)	0.017
Two biological parent home						
Single parent home	0.55	(0.44, 5.57)	0.314	0.73	(0.58, 4.52)	0.455
Blended home	1.57	(0.17, 1.77)	0.488	1.63	(0.31, 1.68)	0.348
Other	2.66	(0.84, 8.31)	0.093	2.37	(0.97, 5.81)	0.059

ACEs: Adverse Childhood Experiences; AOR: Adjusted Odds Ratio; CI: Confidence Interval; EPQR: Eysenck Personality Questionnaire Revised;; NLSCY: National Longitudinal Survey of Children and Youth