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Doidge JC, Higgins DJ, Delfabbro P and Segal L. Risk factors for child maltreatment in an Australian population-based birth cohort. *Child Abuse & Neglect*. 2017 (published online 25 December 2016); 64: 47-60. <http://doi.org/10.1016/j.chiabu.2016.12.002>

Title: Risk factors for child maltreatment in an Australian population-based birth cohort

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Acknowledgements

The Australian Temperament Project is located at The Royal Children's Hospital Melbourne and is a collaboration between Deakin University, The University of Melbourne, The Australian Institute of Family Studies, The University of New South Wales, The University of Otago (NZ), and the Royal Children's Hospital; further information available at www.aifs.gov.au/atp. Funding for this analysis was supported by a PhD scholarship from the University of South Australia, and the South Australian Health Economics Collaborative (funded by the South Australian Department of Health). The views expressed in this paper are those of the authors and may not reflect those of their organizational affiliations, nor of other collaborating individuals or organizations. We acknowledge all collaborators who have contributed to the Australian Temperament Project, especially Professors Ann Sanson, Margot Prior, Frank Oberklaid, and Ms Diana Smart. We would also like to sincerely thank the participating families for their time and invaluable contribution to the study.

Abstract

1
2 Child maltreatment and other adverse childhood experiences adversely influence
3 population health and socioeconomic outcomes. Knowledge of the risk factors for child
4 maltreatment can be used to identify children at risk and may represent opportunities for
5 prevention. We examined a range of possible child, parent and family risk factors for child
6 maltreatment in a prospective 27-year population-based birth cohort of 2,443 Australians.
7 Physical abuse, sexual abuse, emotional abuse, neglect and witnessing of domestic violence
8 were recorded retrospectively in early adulthood. Potential risk factors were collected
9 prospectively during childhood or reported retrospectively. Associations were estimated
10 using bivariate and multivariate logistic regressions and combined into cumulative risk
11 scores. Higher levels of economic disadvantage, poor parental mental health and substance
12 use, and social instability were strongly associated with increased risk of child maltreatment.
13 Indicators of child health displayed mixed associations and infant temperament was
14 uncorrelated to maltreatment. Some differences were observed across types of maltreatment
15 but risk profiles were generally similar. In multivariate analyses, nine independent risk
16 factors were identified, including some that are potentially modifiable: economic
17 disadvantage and parental substance use problems. Risk of maltreatment increased
18 exponentially with the number of risk factors experienced, with prevalence of maltreatment
19 in the highest risk groups exceeding 80%. A cumulative risk score based on the independent
20 risk factors allowed identification of individuals at very high risk of maltreatment, while a
21 score that incorporated all significant risk and protective factors provided better identification
22 of low-risk individuals.

23

24 **Keywords:** child abuse and neglect; child maltreatment; risk factors; cohort studies;

25 prevention

26 Risk Factors for Child Maltreatment in an Australian Population-Based Birth Cohort

27 **Introduction**

28 Adverse childhood experiences such as child abuse and neglect exert a high toll on
29 population health, making prevention of child maltreatment a priority in both developing and
30 developed countries (Gilbert et al., 2009; United Nations Children's Fund, 2012). Research
31 which identifies the predictors of child maltreatment can inform and enhance prevention
32 initiatives in two ways: by identifying vulnerable 'high-risk' individuals or groups for better
33 targeting of prevention services, and by highlighting modifiable mechanisms through which
34 prevention initiatives—or harmful policies—may operate (Gilbert, Woodman, & Logan,
35 2012).

36 Child maltreatment has been a topic of increasing public concern and research interest
37 since the mid-twentieth century, following the seminal publication of "The battered-child
38 syndrome" by Kempe, Silverman, Steele, Droegemueller, and Silver (1962). There have been
39 many studies that have identified risk factors for child maltreatment—for example, see Black,
40 Heyman, and Smith Slep (2001) or Stith et al. (2009) for reviews of child, parent and family
41 factors, and Drake and Jonson-Reid (2014) for a review of economic factors. Opportunities
42 for the simultaneous assessment of relationships between the wide range of identified risk
43 factors and many forms of maltreatment are, however, relatively uncommon. They require
44 large collections of data that can usually only be obtained from population-based surveys.

45 As child maltreatment occurs during childhood and its risk factors necessarily precede
46 it, retrospective surveys of adult populations are of limited use. Not only do they typically
47 collect data long after the events have transpired, but the representativeness of population
48 samples who are recruited after the consequences of child maltreatment have been effected is
49 questionable. Those who have experienced the more severe consequences of child
50 maltreatment (such as homelessness, hospitalization, incarceration, and death) are routinely

51 excluded from sampling frames of adult populations. In contrast, prospective surveys of
52 families through childhood (birth cohorts) provide opportunities for recruitment of
53 representative samples (through near-universal contact with perinatal services in most
54 developed countries), and for information about risk factors to be collected early in the life of
55 participants. This study uses data from a population-based birth cohort, the Australian
56 Temperament Project (ATP), to identify child, parent and family risk factors for child
57 maltreatment, and explore their cumulative implications for risk.

58 *Conceptual models for the risk and etiology of child maltreatment*

59 Just as the study of risk factors for maltreatment can assist in the refinement of causal
60 models, a review of postulated causal models can in turn highlight the domains in which risk
61 factors are likely to found. Conventional *pathway* models of causation (e.g., Bittner and
62 Newberger (1981) or Conger and Donnellan (2007)) include proximal causes of child
63 maltreatment, such as characteristics of the child, the parents and the parent-child
64 relationship, and more distal contextual factors in the family, social, economic and legislative
65 environments (Lamont & Price-Robertson, 2013). *Ecological* models classify risk factors into
66 different levels, acknowledging that each is implicated in the etiology without necessarily
67 being chained together into sequential pathways. Sidebotham (2001) proposes an example of
68 an ecological model, in which parent-child interaction occurs within the context of parents'
69 ontogenic development (factors in the parents' background that may be related to their current
70 parenting), a microsystem of factors relating primarily to the child, an exosystem of factors
71 relating mostly to the family, and a macrosystem of factors relating to the wider community
72 and culture in which the family exists.

73 Another way of conceptualizing the determinants of child maltreatment—one that
74 seems especially relevant to analyses of risk (as opposed to causal effects)—is an approach
75 often referred to as 'cumulative risk'. A cumulative risk approach acknowledges that when

76 there are many separate and interacting effects, a count of risk factors may provide a simple
77 but effective means of identifying risk. This implies a conceptual model in which risk factors
78 can be treated interchangeably, and simplifies the statistical models required for analysis.
79 MacKenzie, Kotch, and Lee (2011) present a cumulative risk analysis of parent and family
80 risk factors for child maltreatment, and the Adverse Childhood Experiences study (Felitti et
81 al., 1998, and many subsequent publications) is an example of a cumulative risk approach to
82 analyzing the consequences of child maltreatment.

83 In theory, the best factors to include in a cumulative risk score are independent
84 correlates of the outcome, as risk factors that are closely related should provide less
85 additional information. In the analysis below, we explore this hypothesis by comparing two
86 different cumulative risk scores: one that is derived using all identifiable risk factors for child
87 maltreatment, and one using only those which are independent predictors in multivariate
88 analysis. We focus on child, parent and family factors that are likely to be identifiable prior to
89 maltreatment occurring (although some were recorded retrospectively in this study). Factors
90 relating to parent-child interaction (warmth, affection, disciplinary style, etc.) are very closely
91 related to the concept of child maltreatment itself, arguably occurring along a spectrum that
92 includes maltreatment (Gilbert et al., 2012), so were excluded from this analysis.

93 Community-level risk factors for child maltreatment were not available in the data.

94 *Child, parent and family risk factors for child maltreatment*

95 Documented child-level risk factors for maltreatment include age, gender,
96 race/ethnicity, developmental status, behavior and social skills, disability and health, and
97 school enrolment (Lamont & Price-Robertson, 2013; Sedlak et al., 2010; Stith et al., 2009). In
98 their analysis of self-reported and official records of child maltreatment in a New York
99 cohort, Brown, Cohen, Johnson, and Salzinger (1998) identified perinatal complications,
100 disability, low verbal IQ, difficult temperament and anxiety/withdrawal as significant

101 predictors of child maltreatment. Using Australian administrative data, O'Donnell et al.
102 (2010) identified female gender and birth defects as being weakly associated with
103 substantiated child maltreatment, and intellectual disability as being a strong predictor. Most
104 other longitudinal studies of risk factors for child maltreatment have focused on parent and
105 family factors (e.g. Sidebotham and Golding (2001) in the UK Avon Longitudinal Study of
106 Parents and Children (ALSPAC), Martin et al. (2011) in the Australian Mater–University of
107 Queensland Study of Pregnancy (MUSP), and Hussey, Chang, and Kotch (2006) in the US
108 Longitudinal Study of Adolescent Health (Add Health)).

109 Child factors are problematic when considering causal models; most child risk factors
110 also represent potential outcomes of child maltreatment (which can include perinatal health
111 and development affected by prenatal substance abuse or violence), and this endogeneity may
112 explain part or all of observed correlations. However, the potential endogeneity of child
113 factors does not limit their use in secondary prevention applications, as children who have
114 been previously maltreated are certainly at high risk of continued or repeated exposure.
115 MacKenzie et al. (2011) did not include any child level risk factors in their analysis of the
116 cumulative risk of maltreatment.

117 Parent and family factors that have been associated with child maltreatment include
118 demographic characteristics (e.g., age, race, family size and structure), socioeconomic status
119 (parental income, education, occupation and housing), parental employment status, parental
120 mental health and substance use, parents' own childhood experiences (particularly exposure
121 to child maltreatment), and family/social instability (Black et al., 2001; Sedlak et al., 2010;
122 Stith et al., 2009). Along with factors relating to parent-child interaction (warmth, discipline,
123 etc.), these have received much greater attention in the literature, with early research focusing
124 more on parental psychopathology and recent research focusing more on socioeconomic
125 influences. Far more specific factors have been identified than could be listed here. In major

126 longitudinal studies, Brown et al. (1998; New York) focus on maternal mental health and
127 socioeconomic status, while Sidebotham and Golding (2001; ALSPAC) focus on parental
128 childhood experiences and mental health. Both Hussey et al. (2006; Add Health) and Martin
129 et al. (2011; MUSP) focus on demographic characteristics and socioeconomic status.

130 Few studies—none in Australia—have simultaneously examined child, parent and
131 family risk factors, or the full range of types of maltreatment. The U.S. National Incidence
132 Study of Child Abuse and Neglect (NIS; Sedlak et al., 2010) routinely collects data on a
133 range of child and parent/family-level risk factors in a sample of incident cases of
134 maltreatment. Incident cases are identified over a one year period by a sample representing
135 most of the agencies and professionals who have regular contact with children. Studies like
136 the NIS allow for some comparisons to be made between risk factors and across types of
137 maltreatment. That study for example, indicated a stronger association between
138 socioeconomic status and child neglect, than for child abuse. However, being based on
139 incident cases of maltreatment that were detected within a one-year period, these findings
140 may be influenced by differences in the frequencies of different types of maltreatment and by
141 different rates of detection. Prospective cohorts, on the other hand, aim to capture the
142 experiences of children for whom maltreatment is not detected, across their entire childhood.

143 *The Australian Temperament Project and aims of the current study*

144 The ATP is a prospective birth cohort that has surveyed a population-based cohort of
145 children, their parents, nurses and teachers, over 27 years (a 32-year follow-up was recently
146 completed but was not ready for inclusion in this analysis). Retrospective self-reports of child
147 maltreatment were obtained when cohort members were young adults. Information about
148 demographic characteristics and socioeconomic disadvantage are particularly detailed, with
149 coverage also of parental mental health and substance use, child health and temperament, and
150 family instability. We aimed to explore these child, parent and family risk factors for child

151 maltreatment, in order to identify high risk groups and potentially-modifiable factors that
152 stand out in multivariate models as independent predictors of each type of child maltreatment.
153 A secondary aim was to explore for the derivation and utility of cumulative risk scores based
154 on the identified risk factors.

155 **Methods**

156 The following summarizes the design of the ATP as relevant to this analysis. For
157 further details about the ATP, see Prior, Sanson, Smart, and Oberklaid (2000).

158 *Participants*

159 A cohort of 2,443 infants were enrolled from a stratified random sample of local
160 government areas that were selected to provide a sampling frame that would be representative
161 of the Victorian state population in terms of geographic location and socioeconomic
162 status (Sanson & Oberklaid, 1985). Questionnaires were distributed to the nurse and
163 caregiver of every infant aged 4–8 months who attended an Infant Welfare Centre (now
164 called ‘Maternal & Child Health Centre’) within a selected local government area during a
165 two-week period in 1983. Distributions of demographic and socioeconomic characteristics in
166 the cohort at baseline were consistent with census data (Sanson & Oberklaid, 1985).

167 *Data*

168 At the time of this analysis, 15 waves of follow-up questionnaires had been
169 administered over 27 years to cohort members (8 waves from age 11), parents (every wave),
170 and nurses (wave 1; information from teacher surveys was not used in this analysis).
171 Variables used in this analysis are described below and grouped into conceptually distinct
172 domains: indicators of child maltreatment, child health, child temperament, demographic
173 characteristics (child or family), economic factors (parent or family), parental mental health
174 and substance use, and social instability. Question wording and response coding are detailed
175 in Table 1.

176 *Child maltreatment.* Exposure to child maltreatment was assessed retrospectively in
177 wave 14 (age 22–23 years) by cohort members' response to questions relating to physical
178 abuse (severe enough to have effects lasting until the next day), sexual abuse (from either of
179 two questions: one concerning sexual advances by family members, and one encompassing
180 any non-consensual sexual experiences before age 16), emotional abuse (threats, humiliation,
181 etc., separated into high-intensity and low-intensity indicators), neglect (subjectively
182 determined by the cohort member) and witnessing of domestic violence (considered here as a
183 form of psychological abuse). Differences between these measures and comparable studies
184 are reviewed in the Discussion. Information about the timing of maltreatment was not
185 available, so in selecting risk factors for consideration, priority was given to the earliest
186 measures of each risk factor. The ATP team has always offered a referral service. Participants
187 are encouraged to contact the team if they have "any questions, concerns or worries" they
188 wish to discuss. A trained psychologist on the team will then offer them support by phone,
189 and refer them to appropriate services if needed. Similarly, if in the course of fieldwork, an
190 interviewer/researcher becomes concerned about the wellbeing of a participant, they will
191 offer the participant the opportunity to speak to a psychologist on the team, who once again
192 will provide support by phone and refer on as needed.

193 *Risk factors.* Many likely risk factors for child maltreatment had been measured at
194 multiple points in time (e.g., parental education was recorded in every wave). After
195 collapsing these by discarding repeated measures (e.g. only the first measure of parental
196 education was used, which was observed to be a better discriminator of maltreatment risk
197 than subsequent measures of parental education), or pooling (e.g., parental unemployment
198 during the previous year at five points in time was combined into a single measure parental
199 unemployment during childhood), we identified a core set of 37 likely risk factors for
200 analysis. Risk factors were then further collapsed into binary indicators to facilitate

201 comparisons and multiple imputation of missing data. Thresholds for dichotomization were
202 selected to maximize discrimination of risk of any child maltreatment, using raw table data
203 and plots of their pairwise associations with risk of child maltreatment (where variables have
204 been collapsed, table data are provided in the Supplementary Appendix).

205 Prospective indicators of *child health* included prematurity, dysmaturity, low and high
206 birthweight for gestational age, perinatal stress, low weight at 4–8 months, and the number of
207 investigated health problems by 3–4 years. These were supplemented by retrospective self-
208 report of physical health problems and cognitive/behavioral problems during childhood.

209 By definition, *temperament* relates to aspects of personality that are fixed (Thomas,
210 Chess, Birch, Hertzog, & Korn, 1963). In practice, measurement of temperament is closely
211 related to behaviors that may be influenced by things like adverse childhood experiences. To
212 minimize the potential for endogeneity, indicators of temperament were derived from earliest
213 available measurements, at 4–8 months. Factor scales based on the Revised Infant
214 Temperament Questionnaire (Carey & McDevitt, 1978) had previously been derived using
215 the ATP sample (Sanson, Prior, Garino, Oberklaid, & Sewell, 1987). These were
216 supplemented by composite measure of behavioral problems and overall ratings of child
217 difficulty by the mother and the nurse.

218 *Demographic characteristics* included cohort gender, parental ages, parental
219 immigration status, and family size (more than 4 children).

220 Parent and family *economic factors* included the first reported levels of parental
221 education and occupation, a combined measure of parental unemployment over childhood,
222 the type of housing in early childhood, and retrospective self-report of poverty while growing
223 up.

224 Indicators of *parental mental health and substance use* included parents' self-report of
225 alcohol use and tobacco at two points during the cohort's adolescence, and cohort members'
226 retrospective report of parental mental illness and substance use problems while growing up.

227 Indicators of *social instability* included the total number of house moves experienced
228 by the cohort member during childhood, the frequency of school moves, and the cohort
229 members' experience of parental separation or divorce during childhood.

230 *Analysis*

231 Because of the large amount of missing data that characterize birth cohorts with long
232 periods of follow-up, and because of particular concern about the expected relationship
233 between child maltreatment and loss to follow-up/non-response, the first step in the analysis
234 was a detailed accounting of missing data. Strong associations were observed between
235 retrospective reports of child maltreatment in wave 14 and response by both parents and
236 cohort members in other waves (Doidge, Edwards, Higgins, & Segal, 2016). To address this,
237 we used responsiveness-informed multiple imputation (Doidge, 2016), a technique
238 incorporating measures of cohort and parent responsiveness, along with other risk factors and
239 outcomes of child maltreatment, as auxiliary variables in imputation models. Utilizing
240 measures of participant responsiveness in this way has been shown to mitigate bias when
241 there are direct relationships between variables of interest and the likelihood of data being
242 missing (Doidge, 2016). Twenty imputation sets were generated using multiple imputation by
243 chained equations (van Buuren, 2007). Further details about imputation models can be found
244 in Doidge et al. (2016) or from the corresponding author.

245 After collapsing and multiple imputation of variables, the odds ratio (OR) for child
246 maltreatment were estimated for each combination of potential risk factor and type of
247 maltreatment. Imputed estimates were compared with raw (unimputed) estimates to
248 determine the likely influence of missing data on these. To identify risk factors that

249 independently predicted risk of child maltreatment, conditional OR were estimated using
250 multivariate logistic regressions of each type of maltreatment upon all of the potential risk
251 factors. Lastly, two cumulative risk measures were devised: one incorporating all risk factors
252 that were significant in their binary correlations with overall risk of child maltreatment and
253 one incorporating only the significant independent risk factors from the multivariate model.
254 The associations between each cumulative risk score and child maltreatment were explored
255 graphically.

256 All analyses were performed using Stata 12 (StataCorp 2011, College Station, TX).

257 **Results**

258 *Exploration and transformation of non-binary variables*

259 Before commencing multiple imputation and the substantive analyses, the raw
260 associations between likely risk factors and overall risk of child maltreatment were reviewed
261 to identify appropriate thresholds for collapsing continuous, ordinal, multinomial and count
262 variables into binary risk factors. Raw tables are provided in the Supplementary Appendix.
263 Risk of maltreatment was higher in younger parents but appeared to flatten out beyond 22
264 years. There was some indication of increased risk again beyond 37 years, but there were few
265 older parents in this cohort, the association was not as strong or statistically significant, so
266 only young parenthood was included as a binary risk factor. Risk of maltreatment increased
267 slightly beyond four children in the family but appeared stable up until that point.
268 Significantly higher rates of maltreatment were observed in children of parents who had
269 immigrated from non-English-speaking countries but not in children of parents from English-
270 speaking countries.

271 In terms of child health, low birthweight was associated with increased risk of
272 maltreatment below the 3rd percentile but not between the 3rd and 10th percentiles. Having
273 required professional help for one type of health problem by age 3 was not associated with

274 increased risk of child maltreatment but risk was increased in those whose parents reported
275 two or more types of health problem. Temperament factor scales were skewed continuous
276 variables ranging between 1 and 6, and did not exhibit any apparent associations with child
277 maltreatment so the highest tertile was selected as likely compromise between strength and
278 power.

279 In the economic factors, having one out of 10 possible reports of parental
280 unemployment during the previous year was uncorrelated with child maltreatment, but risk
281 increased appreciably for people with two or more reports. The risk of child maltreatment
282 was noticeably lower in people whose parents were at least tertiary educated or were in
283 professional or managerial occupations, but fairly constant across other groups. Thus, high
284 education and occupation levels may represent protective factors, but these were reverse
285 coded to maintain consistency with other risk factors (i.e. the variables used were
286 "mother's/father's first reported education < tertiary " and "mother's/father's first reported
287 occupation < professional/managerial"). The noticeable difference in risk according to
288 housing type, was between owner-occupied accommodation (being lower) and other types.

289 With respect to parental mental health and substance use, maltreatment was associated
290 with any parental smoking but did not vary greatly by level of smoking, and was increased in
291 people whose parents reported being either an "ex-drinker" or a "heavy drinker" during the
292 cohort member's adolescence. These two categories were therefore pooled.

293 Household mobility was not significantly associated with increased risk of child
294 maltreatment until at least 10 house moves were reported during childhood, while school
295 mobility was associated with increased risk of maltreatment when the child had moved
296 schools more than once in every two years.

297 *Multiple imputation*

298 The prevalence of binary characteristics, before and after multiple imputation, are
299 presented in Table 2. Comparison of raw and multiply imputed estimates indicated that, along
300 with child maltreatment, most likely risk factors for child maltreatment were also associated
301 with non-response or loss to follow-up. Economic disadvantage and parental mental illness
302 and substance use were strongly associated with the likelihood of having missing data, as
303 were most demographic characteristics suspected of being risk factors for child maltreatment.
304 Multiply imputed estimates of the prevalence of child maltreatment were roughly twice as
305 high as in the complete case data.

306 *Binary risk factors for child maltreatment*

307 Odds ratios for each combination of risk factor and child maltreatment indicator are
308 presented in Table 3. Compared with the differences seen in prevalence estimates, the
309 differences between raw and multiply imputed OR tended to be smaller and all were non-
310 significant (test statistics not shown).

311 Indicators of child health displayed a mixed picture of association with child
312 maltreatment, with some exhibiting strong and significant associations (e.g. retrospective
313 reports of cognitive or behavioral problems was significantly correlated with most specific
314 types of maltreatment and had an overall OR of 2.61) while others appeared uncorrelated
315 (e.g. high birthweight or prematurity). Early indicators of child temperament did not predict
316 child maltreatment at all. Of the demographic factors, only young parental ages and parental
317 immigration from non-English speaking countries significantly predicted higher risk of child
318 maltreatment. All selected indicators of economic disadvantage, parental mental illness and
319 substance use, and social instability strongly predicted increased risk of child maltreatment.

320 The overall pattern of risk factors was fairly consistent across types of child
321 maltreatment although some differences were apparent. Male participants were more likely to

322 report physical abuse and neglect, although the differences were not statistically significant.
323 The number of investigated child health problems was most strongly predictive of exposure
324 to domestic violence. Young parental ages were not associated with physical abuse or
325 neglect, but were associated with other forms of maltreatment (it is worth noting, however,
326 the high proportion of imputed data in subgroups with low parental age, who were highly
327 prone to loss to follow-up). Parental immigration from non-English-speaking countries
328 significantly predicted only sexual abuse, although a trend was noted for physical abuse also.

329 *Independent risk factors for child maltreatment*

330 Conditional OR from logistic regressions are presented in Table 4. In relation to risk
331 of any maltreatment 12 of the 21 risk factors that were statistically significant in bivariate
332 analyses became non-significant when controlling for other risk factors. However, many of
333 the other estimates reduced only slightly in strength and retained substantial point estimates
334 (e.g. OR > 1.5), despite losing statistical significance. For child health, each of the significant
335 OR reduced slightly and only retrospective self-report of cognitive or behavioral problems
336 remained statistically significant with respect to any maltreatment. Of the demographic
337 factors, both parental immigration and maternal age < 22 years remained significant, while
338 paternal age < 22 years became non-significant. Of the economic factors, parental
339 unemployment and retrospective perception of poverty remained significant. Cohort-reported
340 indicators of parental mental illness and substance use remained significant, while parent-
341 reported measures diminished. Frequent school mobility and parental separation or divorce
342 also remained significant independent correlates of child maltreatment.

343 In multivariate regressions, the distinctions between different types of child
344 maltreatment became somewhat more apparent. After conditioning on other risk factors,
345 young maternal age was only predictive of emotional abuse, while paternal occupation class
346 independently predicted only physical abuse.

347 *Cumulative risk of child maltreatment*

348 Of the 37 binary risk factors selected, 21 were significantly correlated with risk of any
349 child maltreatment, and 9 remained significant when controlling for other risk factors. Of the
350 21 significant risk factors, the number experienced by participants was only slightly skewed,
351 with a mean of 5.6, a median of 6, and a range of 0–16 (see dotted line in Figure 1(c)). As
352 the number of risk factors increased, the risk of most forms of maltreatment increased
353 exponentially (Figure 1(a)). In the most disadvantaged 4.3% of the population (those with
354 more than 10 risk factors for child maltreatment) 83.3% reported at least one type of
355 maltreatment and 63.8% reported multiple types, compared with only 7.1% and 0.8%
356 respectively in the 2.3% of people who had no identified risk factors (OR = 65.26 for any
357 maltreatment and OR = 218.54 for multi-type maltreatment). Excluding low-intensity
358 emotional abuse, these figures were 73.1% and 44.0% compared with 6.5% and 0.5%,
359 respectively (OR = 39.09 and OR = 156.36, respectively). People with more than 10 risk
360 factors experienced 9.4% of all child maltreatment and 18.4% of multi-type maltreatment.
361 The most disadvantaged 23.4% (people with more than 7 risk factors) accounted for 40.1% of
362 all child maltreatment and 60.2% of multi-type maltreatment.

363 The distribution of the number of *independent* risk factors (out of 9) was much more
364 skewed, with 25.8% of the cohort having no risk factors (Figure 1(c)). The relationship
365 between the number of independent risk factors and risk of child maltreatment was more
366 linear than the relationship with the number of significant risk factors and started from a
367 much higher level of risk. While a cumulative risk score that counted only independent risk
368 factors was able to identify high-risk individuals in a similar fashion to a count of all
369 significant risk factors (people with 4 or more independent risk factors had a similar risk
370 profile to those with 10 or more significant risk factors), the pooling of categories at the low
371 end of the risk spectrum (people with no independent risk factors) meant that individuals at

372 very low risk of maltreatment were not as well identified using this coarser measure of
373 cumulative risk.

374 **Discussion**

375 *Summary of findings*

376 While risk factors for child maltreatment have long been a topic of research, this
377 analysis is the first to use prospective Australian data to explore a wide range of risk factors
378 simultaneously and allow comparisons of risk factors across all types of abuse or neglect. We
379 found that indicators of economic disadvantage, parental mental illness and substance use,
380 and social instability were the strongest and most consistent correlates of child maltreatment.
381 Inconsistent findings were observed amongst child-level risk factors, with no correlations of
382 child maltreatment to early indicators of temperament, but some correlations to prospective
383 and retrospective indicators of poor child health, and retrospective self-report of cognitive or
384 behavioral problems. Multivariate analyses identified a smaller set of risk factors that were
385 independently correlated with child maltreatment in our sample, including demographic
386 factors and indicators of child health, economic disadvantage, parental mental illness and
387 substance use, and social instability. While the breadth of these independent correlates
388 indicates complex etiologies, a general consistency across types of maltreatment implies a
389 fair degree of commonality in the underlying mechanisms.

390 The exponential shapes of the cumulative risk curves indicate interactions between
391 risk factors, in that each additional risk factor that a participant experienced increased their
392 risk of child maltreatment by more than the last. While the most disadvantaged children are
393 identified as being at greatest risk of abuse, it is also worth noting that maltreatment occurred
394 in all socioeconomic groups. A low cumulative risk score that had been calculated using all
395 21 significant risk factors was able identify children with very low risk of maltreatment,
396 while a cruder score based on only nine independent risk factors was not. It is likely that

397 scores which include for protective factors as well as risk factors provide better
398 discrimination in this regard. This may be an explanation for the differences observed
399 between our scores, as the indicators of parental education, occupation and smoking were, in
400 effect, reverse-coded indicators of high education, high occupation class, and never having
401 smoked (i.e. more people experienced 'low' parental education, 'low' parental occupation, and
402 had parents who had ever smoked, than did not).

403 *Limitations*

404 Dichotomization of risk factors was used in the interests of clarity, to accommodate
405 multivariate models with more independent variables, and—importantly—to allow a more
406 sophisticated approach to addressing missing data. The multivariate analyses presented
407 should not be interpreted as theoretically consistent causal models. Instead, they are an
408 exploratory analysis to identify independent predictors of child maltreatment in this
409 Australian population-based cohort. More nuanced interpretations could be revealed by more
410 focused analyses of theory-based causal models and by using finer levels of measurement
411 than are reflected in our binary risk factor designations. The analysis also focuses on risk
412 factors operating at the level of the child, parent or family; a more complete picture would
413 include community-level (e.g. community-level disadvantage and local crime rates) and
414 population-level (e.g. economic productivity/recessions) risk factors. Such an analysis would
415 require a larger sample, spread over geographic location and time.

416 There are other limitations to note. Not all of the risk factors were measured
417 prospectively, and the retrospectively reported measures, which may have occurred after
418 maltreatment, tended to be stronger 'predictors' than the prospectively collected measures.
419 The retrospective measures—including measures of child maltreatment—may be prone to
420 recall bias; people who experience maltreatment might be more likely to report certain risk

421 factors, or people who experience higher levels of disadvantage may be more likely to
422 identify their childhood experiences as abusive or neglectful.

423 As well as being measured retrospectively, there are some notable differences
424 between the Australian Temperament Project measures of adverse childhood experiences and
425 others reported in the literature. Our measures of emotional abuse, neglect, and witnessing of
426 domestic violence were subjectively phrased and based on ordinal response scales. Questions
427 relating to sexual abuse were less detailed than most other surveys of child abuse. Our
428 prevalence estimate for domestic violence was lower than reported in most other literature on
429 the topic (Hamby, Finkelhor, Turner, & Ormrod, 2011). Prevalence estimates for other types
430 of maltreatment were within the admittedly large range of comparable estimates for
431 Australia (Price-Robertson, Bromfield, & Vassallo, 2010).

432 Analysis of missing data indicated strong associations between loss to follow-up/non-
433 response and child maltreatment, as well as with some risk factors. Rather than reflecting a
434 limitation of the study, the use of a rigorous and sophisticated approach to adjusting for the
435 missing data is, we feel, one of its main strengths. All long-term cohort studies involve
436 substantial amounts of missing data, although the extent is not always clearly reported.
437 Adverse childhood experiences can be expected to be strongly associated with loss to follow-
438 up and non-response, by both parents and cohort members, and the methods commonly
439 employed to address this problem are unlikely to be sufficient (Doidge et al., 2016).
440 Accordingly, we employed an extended form of multiple imputation (responsiveness-
441 informed multiple imputation), developed specifically for addressing bias from missing data
442 in such applications, and tested it under simulation before employing it here (Doidge, 2016).
443 The method uses information about the responsiveness of parents and cohort members at
444 other points in time, as auxiliary variables in imputation models. Moreover, we included a
445 wide range of other auxiliary variables, such as outcomes of child maltreatment, to minimize

446 bias in imputations. It is only by comparing these imputations with the observed data, that the
447 likely biases in the observed data are revealed. Lastly, while the biases were substantial for
448 prevalence estimates, the revealed biases in odds ratios were generally small. Any residual
449 (unaccounted for) bias in these, is therefore also likely to be small.

450 Aboriginal people and Torres Strait Islanders represent too small a portion of the
451 Victorian population to be identified in this cohort. This is potentially problematic in that
452 studies show that the Indigenous population experiences a much greater level of
453 disadvantage in many areas, including a much higher prevalence of involvement with the
454 child protection system (Delfabbro, Hirte, Rogers, & Wilson, 2010). Thus, we cannot be
455 certain the results are generalizable to such groups. Similar caveats apply to international
456 generalizations of the findings to other countries where there may be differences in social
457 support systems and levels of inequality that may influence the relative and absolute
458 importance of particular risk factors. Amongst culturally and socioeconomically similar
459 countries, findings are likely to be (and have been) consistent with ours in terms of identified
460 risk factors (Lamont & Price-Robertson, 2013; Stith et al., 2009).

461 *Conclusion*

462 This study highlights the social groups in Australia which are most vulnerable to child
463 maltreatment. These include those experiencing higher levels of socioeconomic disadvantage,
464 parental mental illness, substance use problems, and social instability. We identified nine
465 independent risk factors for child maltreatment in Australia that could be used to create a risk
466 score that identifies children at increased risk of maltreatment, and a set of 21 risk and
467 protective factors that provide better discrimination of children at low risk of maltreatment.
468 Many of these risk factors warrant a more focused analysis or further research to answer
469 questions such as whether the differences in risk by parental country of birth reflect
470 socioeconomic, cultural or other differences. The causal contribution of independent risk

471 factors to increasing risk of child maltreatment warrants further exploration, as does the
472 mechanisms through which they operate. Better understanding of the causal relationships will
473 allow interventions to be designed and targeted to enhance the effectiveness of prevention
474 strategies.

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Table 1 Derivation of variables

Variable	Item and binary response coding	Recorded at (by)
Child maltreatment		
Emotional abuse	"Somewhat true" (low intensity) or "very true" (high intensity) on a 5-point scale to <i>"You experienced verbal treatment from your parent/s that made you feel embarrassed, humiliated or scared (e.g. shouting, name calling, threats)"</i>	23–24 years (cohort)
Neglect	"Somewhat untrue" or "very true" to <i>"The care taken of you by your parent/s was the right amount (e.g. they watched out for you, fed you properly, gave you attention)"</i>	23–24 years (cohort)
Physical abuse	"Yes" to a) <i>"Your parent/s used harsh physical treatment (e.g. smacking hitting) to discipline you"</i> AND b) <i>"Did you ever suffer effects that lasted to the next day or longer (e.g. bruising, marking, pain, soreness)?"</i>	23–24 years (cohort)
Sexual abuse	"Yes" to a) <i>"A family member did, or tried to do sexual things to you"</i> OR b) <i>"You had a [nonconsensual] sexual experience with a person who was not a family member before you were 16"</i>	23–24 years (cohort)
Witnessing domestic violence	"Somewhat true" or "very true" on a 5-point scale to <i>"There was physical violence between the adults caring for you"</i>	23–24 years (cohort)
Child health		
At least 2 investigated health problems by age 3	<i>"Has your child ever needed professional help with any of the following: [list of 8 common types of child health problem plus 'other']"</i>	3–4 years (parent)
Below 3rd pc weight at 4-8 months	Check box	4–8 months (nurse)

(Table continues over page)

Variable	Item and binary response coding	Recorded at (by)
Birthweight [$< 3^{\text{rd}}$ pc/ $> 97^{\text{th}}$ pc]	Derived from birthweight and gestational age against percentiles from Roberts and Lancaster (1999)	4–8 months (nurse)
Dysmature	Check box	4–8 months (nurse)
Gestational age < 37 weeks	Derived from gestational age in weeks	4–8 months (nurse)
Perinatal stress	Check box	4–8 months (nurse)
Retrospective self-report of cognitive or behavioral/physical health problems while growing up	<i>"You experienced a long-term or serious medical or psychological problem (e.g. asthma, learning problems, ADHD, depression)"</i> [Yes/No and 'Please describe']. Text responses were categorized as either cognitive/behavioral, physical, or both.	23–24 years (cohort)
Child temperament		
[Activity/approach/behavior/cooperation/irritability/rhythmicity] factor scale	Australian Temperament Project factor scales (Sanson et al., 1987), based on responses to revised Infant Temperament Questionnaire (Carey & McDevitt, 1978). Highest tertiles selected for binary classification.	4–8 months (parent)
Behavior problems composite	Mean of three 5-point scales relating to colic, sleep problems and excessive crying.	4–8 months (parent)
Mother's overall rating of child difficulty	<i>"Compared to other babies, I think my baby is: (circle one) Much easier than average; Easier than average; Average; More difficult than average; Much more difficult than average"</i> . 'More' or 'much more' combined for binary classification.	4–8 months (parent)
Nurse's overall rating of child difficulty	<i>"In your opinion, the baby's temperament is: ..."</i> [responses and coding as per mother's rating]	4–8 months (nurse)
Demographic factors		
At least one parent from non-English-Speaking country	Derived from mother and father's country of birth	4–8 months (parent)
[Father/Mother] < 22 yo at birth	Mother and father's age at baseline (4–8 months)	4–8 months (parent)
Gender = male	Check box	4–8 months (parent)
More than 4 children in family	<i>"I have a total of children"</i> [maximum number recorded at four points during childhood]	11–12, 12–13, 13–14 and 17–18 years

(Table continues over page)

Variable	Item and binary response coding	Recorded at (by)
Economic factors		
[Mother's/father's] education	Check boxes based on an 8-point scale adapted from Brotherton, Kotler, and Hammond (1979). Less than tertiary was selected for binary classification.	4–8 months or earliest record
[Mother's/father's] occupation	text, coded according to 6-point scale by Broom, Lancaster, and Zubrzycki (1976). Less than professional or managerial was selected for binary classification.	4–8 months or earliest record (parent)
Parental unemployment	Number of affirmative responses to " <i>Has [father/mother] been unemployed, but wishing to work, over the last 12 months?</i> " at five points during childhood. A threshold of at least 2 from a possible 10 affirmative responses was selected for binary classification.	9–10, 11–12, 12–13, 13–14, and 15–16 years (parent)
Housing	Check boxes (6). The highest across three points in time was identified and 'other than owner-occupied home or flat' was selected for binary classification.	3–4, 5–6, and 7–8 years (parent)
Poverty	"Somewhat true" of "very true" on 5-point scale to " <i>Your family was poor and struggled to make ends meet</i> "	23–24 years (cohort)
Parental mental health and substance use		
Cohort-reported parental [mental illness/substance use] problem	" <i>Your mother or father had a mental illness or substance use problem</i> " [Yes/No; Who experienced the problem? Please describe the problem/s] Check boxes and text categorized into mother/father and mental illness/substance use problem.	23–24 years (cohort)
Either parent smoked	Check boxes for Mother's/Father's smoking habits: <i>Never smoked/Ex-smoker/Mild smoker/Moderate smoker/Heavy smoker</i> . Any response but "never smoked" from either of two points in adolescence.	13–14 and 17–18 years (parent)
[Father/Mother] ex or heavy drinker during adolescence	Check boxes for Mother's/Father's drinking habits: <i>Never/Ex-drinker/Mild drinker/Moderate drinker/Heavy drinker</i> . Either "ex-drinker" or "heavy drinker" at either of two points in adolescence.	13–14 and 17–18 years (parent)

(Table continues over page)

Variable	Item and binary response coding	Recorded at (by)
Social instability		
High household mobility	<i>"How many house moves has the family made during the life of the ATP child?"</i> Maximum of six points recorded during childhood. Threshold of at least 10 household moves was selected for binary classification.	9–10, 11–12, 12–13, 13–14, 15–16 and 17–18 years (parent)
High school mobility	<i>"How many changes of school has your ATP child had since beginning school?"</i> Recorded at four points during childhood. Each point was divided by the approximate years of schooling to generate a school mobility rate. The maximum rate for each child was identified and a threshold of at least 0.5 school moves per year was selected for binary classification.	11–12, 12–13, 13– 14 and 15–16 years (parent)
Parental separation or divorce	<i>"Yes"</i> to <i>"Have the ATP child's parents separated?"</i> OR <i>"Have the ATP child's parents divorced?"</i>	17–18 years (parent)

Table 2 Participant characteristics

Characteristic	Estimated prevalence, %		
	Raw (missing)	CCA	MI p
<i>n</i>	2,443	358	2,443
Child maltreatment			
High-intensity emotional abuse	3.3 (60.6)	2.2	6.2***
Low-intensity emotional abuse	13.7 (60.6)	10.1	18.9***
Neglect	2.8 (60.5)	3.4	7.9***
Physical abuse	5.8 (60.5)	5.3	9.6***
Sexual abuse	5.8 (60.7)	4.5	11.0***
Witnessed domestic violence	4.4 (60.6)	3.4	8.9***
Child health			
At least 2 investigated health problems by age 3	7.4 (32.8)	5.9	7.5
Below 3rd pc weight at 4-8 months	2.2 (3.5)	0.6	2.3**
Birthweight < 3rd pc	3.2 (11.3)	1.7	3.6*
Birthweight > 97th pc	3.4 (11.3)	3.1	3.8
Dysmature	4.6 (28.1)	4.2	4.9
Gestational age < 37 weeks	5.7 (9.5)	3.6	5.8
Perinatal stress	20.9 (24.8)	15.6	22.2***
Retrospective self-report of cognitive or behavioral problems while growing up	10.9 (60.7)	11.2	14.8*
Retrospective self-report of physical health problems while growing up	12.0 (60.7)	11.5	14.6
Child temperament			
Highest tertile of activity factor scale	28.2 (0.0)	20.4	28.2***
Highest tertile of approach factor scale, 1983	32.3 (0.0)	29.9	32.3
Highest tertile of behavior problems composite, 1983	23.4 (0.4)	22.9	23.5
Highest tertile of cooperation factor scale, 1983	29.2 (0.0)	30.4	29.2
Highest tertile of irritability factor scale, 1983	29.4 (0.0)	30.2	29.4
Highest tertile of rhymicity factor scale, 1983	30.5 (0.0)	29.3	30.5
Mother's overall rating more difficult	6.5 (2.7)	6.1	6.6
Nurse's overall rating more difficult	10.2 (3.9)	8.4	10.3
Demographic factors			
At least one parent from non-ES country	22.0 (2.3)	13.7	22.2***
Father < 22yo at birth	2.5 (1.6)	0.3	2.8***
Gender = male	51.9 (0.0)	40.8	51.9***
More than 4 children in family	5.8 (32.4)	5.3	6.8
Mother < 22yo at birth	7.3 (0.1)	2.0	7.4***
Economic factors			
At least 'somewhat' poor while growing up	17.8 (60.5)	13.7	24.2***
At least 2 points of parental unemployment	27.0 (51.7)	21.5	38.1***
Family did not own home by age 7	8.7 (22.7)	4.5	9.3***
Father's first reported education < tertiary	70.8 (2.7)	63.4	71.1***
Father's first reported occupation < professional/managerial	60.6 (1.6)	52.0	60.9***
Mother's first reported education < tertiary	76.1 (0.9)	66.5	76.3***

(Table continues over page)

Characteristic	Estimated prevalence, %		
	Raw (missing)	CCA	MI p
Mother's first reported occupation < professional/managerial	73.9 (1.9)	65.4	74.2***
Parental mental health and substance use			
Cohort-reported parental mental illness	6.6 (61.1)	4.2	11.2***
Cohort-reported parental substance use problem	4.9 (61.1)	3.6	8.1***
Either parent smoked	67.4 (40.8)	61.7	70.2***
Father ex or heavy drinker during adolescence	7.9 (41.5)	5.6	9.5**
Mother ex or heavy drinker during adolescence	2.1 (41.5)	1.7	3.3
Social instability			
High household mobility	1.9 (32.2)	1.1	2.7*
High school mobility	8.7 (35.3)	7.8	9.6
Parental separation or divorce	20.2 (49.5)	17.9	23.9**

***p < 0.01, **p < 0.05, *p < 0.10 in z-test of H₀: CCA = MI; CCA: complete case analysis (complete on all variables); MI: responsiveness-informed multiple imputation by chained equations

Table 3 Risk factors for child maltreatment: Unadjusted odds ratios, by type of maltreatment

Risk factor	Any child maltreatment		HIE	LIE	Neglect	Physical	Sexual	WDV
	(Raw) OR	(MI) p	(MI) OR	(MI) p	(MI) OR	(MI) p	(MI) OR	(MI) p
Child health								
At least 2 investigated health problems by age 3	1.36	1.55**	1.50	1.48	1.65	1.88*	0.77	2.64***
Below 3rd pc weight at 4-8 months	0.49	0.99	NE	1.15	NE	0.93	0.65	0.92
Birthweight < 3rd pc	2.18*	2.04**	1.52	1.91*	NE	1.46	1.38	2.40
Birthweight > 97th pc	0.85	0.95	1.50	0.95	1.16	1.06	0.62	0.58
Dysmature	0.26*	0.84	0.83	0.92	0.65	0.87	0.61	0.79
Gestational age < 37 weeks	0.55	0.89	0.52	1.16	NE	1.22	NE	NE
Perinatal stress	0.59**	0.94	1.00	0.93	0.90	1.08	0.91	1.06
Retrospective self-report of cognitive or behavioral problems while growing up	2.41***	2.61***	1.93*	2.44***	3.57***	1.84	2.91***	1.10
Retrospective self-report of physical health problems while growing up	1.66**	1.81**	1.48	1.58*	1.43	2.11**	1.50	2.42**
Child temperament								
Highest tertile of activity factor scale	0.92	1.07	1.17	1.10	1.06	0.92	1.17	1.17
Highest tertile of approach factor scale, 1983	1.02	1.12	1.04	1.14	0.97	1.05	1.24	1.33
Highest tertile of behavior problems composite, 1983	0.86	1.04	1.13	1.01	0.93	1.13	1.10	1.20
Highest tertile of cooperation factor scale, 1983	0.82	0.99	0.91	0.98	1.00	1.00	1.01	0.95
Highest tertile of irritability factor scale, 1983	0.84	1.09	1.29	1.06	1.15	1.08	1.09	1.40
Highest tertile of rhythmicity factor scale, 1983	0.95	1.07	1.13	1.05	1.01	1.01	1.10	1.09
Mother's overall rating more difficult	0.79	1.01	1.10	1.13	0.98	1.01	0.92	1.18
Nurse's overall rating more difficult	1.08	1.02	0.94	1.12	1.00	0.95	0.91	1.01
Demographic factors								
At least one parent from non-ES country	1.57**	1.51**	1.34	1.30	0.92	1.56*	1.81**	1.38
Father < 22yo at birth	2.64	3.12***	2.15	2.63**	1.17	1.09	2.53*	2.88*
Gender = male	0.95	1.13	0.86	1.06	1.59	1.50	0.86	0.99
More than 4 children in family	1.10	1.27	0.93	1.30	1.48	1.06	1.38	1.05
Mother < 22yo at birth	2.75***	3.03***	2.06*	3.29***	1.33	0.68	2.55**	2.66**

(Table continues over page)

Risk factor	Any child maltreatment		HIE	LIE	Neglect	Physical	Sexual	WDV
	(Raw) OR	(MI) p	(MI) OR	(MI) p	(MI) OR	(MI) p	(MI) OR	(MI) p
Economic factors								
At least 'somewhat' poor while growing up	3.02***	2.94***	2.64***	2.46***	2.43**	4.05***	2.20***	3.34***
At least 2 points of parental unemployment	2.30***	2.33***	2.22***	1.95***	1.83*	2.11***	2.82***	2.95***
Family did not own home by age 7	2.48***	2.52***	1.87	2.00**	1.37	2.10*	2.79***	2.52**
Father's first reported education < tertiary	1.20	1.46***	1.23	1.24	1.10	1.52*	2.29**	1.87**
Father's first reported occupation < professional/managerial	1.54***	1.57***	1.38	1.29	1.12	2.50***	1.93***	2.42***
Mother's first reported education < tertiary	1.63***	1.64***	1.61	1.60***	1.47	0.92	2.12***	2.80***
Mother's first reported occupation < professional/managerial	1.33*	1.43**	1.53	1.25	1.22	0.97	2.08**	3.05**
Parental mental health and substance use								
Cohort-reported parental mental illness	2.46***	2.77***	2.06*	1.90*	3.60***	2.31**	3.33***	1.71
Cohort-reported parental substance use problem	2.59***	3.34***	3.23***	1.77*	3.35***	2.97***	2.39**	5.50***
Either parent smoked	1.75***	1.71***	2.00**	1.61**	1.72	1.29	1.57	2.48**
Father ex or heavy drinker during adolescence	1.96**	1.93***	2.01**	1.56*	1.96*	1.71*	1.91**	2.11***
Mother ex or heavy drinker during adolescence	2.58*	2.93**	1.92	2.24*	NE	0.92	3.31*	3.42**
Social instability								
High household mobility	1.39	1.90*	1.59	2.16*	1.37	1.51	1.90	2.12
High school mobility	2.38***	2.22***	2.08**	2.04***	1.54	3.61***	1.11	1.91*
Parental separation or divorce	2.81***	2.53***	2.31***	2.01***	2.43***	1.81**	3.28***	3.18***

***p < 0.01, **p < 0.05, *p < 0.10 H₀: odds ratio = 1.00; HIE: high-intensity emotional abuse; LIE: low-intensity emotional abuse; MI: multiply imputed; NE: not estimated because of small cell counts from combining rare exposures with rare outcomes (in each case there were no cases amongst the exposed group in the complete case data and the difference was not significant. Resulting perfect prediction in some imputation datasets produced computational errors.); WDV: witnessed domestic violence

Table 4 Risk factors for child maltreatment: Regression models, by type of maltreatment

Risk factor	Any	HIE	LIE	Neglect	Physical	Sexual	WDV
	OR p	OR p	OR p	OR p	OR p	OR p	OR p
Child health							
At least 2 investigated health problems by age 3	1.37	1.38	1.20	1.28	1.55	0.55	3.09**
Below 3rd pc weight at 4-8 months	0.96	excl.	1.02	excl.	0.89	0.71	0.76
Birthweight < 3rd pc	1.93	1.21	2.04	excl.	1.49	1.53	2.26
Birthweight > 97th pc	0.98	1.81	0.97	1.22	1.13	0.58	0.64
Dysmature	0.88	0.96	0.85	0.79	0.73	0.63	0.67
Gestational age < 37 weeks	0.86	0.49	1.14	excl.	1.39	excl.	excl.
Perinatal stress	0.88	1.02	0.85	0.93	1.02	0.94	0.99
Retrospective self-report of cognitive or behavioral problems while growing up	2.05**	1.42	1.92**	2.70*	1.30	2.15*	0.58
Retrospective self-report of physical health problems while growing up	1.59	1.21	1.27	1.04	1.92*	1.13	2.36*
Child temperament							
Highest tertile of activity factor scale	0.93	1.00	0.98	1.01	0.81	0.98	0.93
Highest tertile of approach factor scale, 1983	1.05	0.94	1.09	0.97	1.06	1.05	1.20
Highest tertile of behavior problems composite, 1983	0.96	1.04	0.91	0.84	1.11	1.05	1.02
Highest tertile of cooperation factor scale, 1983	0.89	0.81	0.91	0.96	0.95	0.95	0.79
Highest tertile of irritability factor scale, 1983	1.00	1.26	0.94	1.17	0.92	0.95	1.26
Highest tertile of rhymicity factor scale, 1983	1.02	1.06	1.01	0.99	0.93	0.97	0.99
Mother's overall rating more difficult	1.00	1.10	1.15	1.06	1.01	0.98	1.11
Nurse's overall rating more difficult	1.01	0.81	1.12	0.96	0.83	0.81	0.84
Demographic factors							
At least one parent from non-ES country	1.54**	1.28	1.30	0.87	1.54	2.00**	1.31
Father < 22yo at birth	1.46	1.25	0.94	1.00	1.50	1.26	1.25
Gender = male	1.27	0.93	1.16	1.87*	1.73*	1.02	1.03
More than 4 children in family	0.85	0.65	0.90	1.12	0.86	0.91	0.63
Mother < 22yo at birth	2.06**	1.43	2.71**	0.88	0.34	1.46	1.53

(Table continues over page)

Risk factor	Any	HIE	LIE	Neglect	Physical	Sexual	WDV
	OR p	OR p	OR p	OR p	OR p	OR p	OR p
Economic factors							
At least 'somewhat' poor while growing up	1.95***	1.72	1.76***	1.77	3.13***	1.12	1.96**
At least 2 points of parental unemployment	1.54***	1.49	1.40	1.28	1.33	1.81**	1.79*
Family did not own home by age 7	1.52	1.09	1.16	0.84	1.48	1.75	1.19
Father's first reported education < tertiary	0.96	0.84	0.87	0.87	0.94	1.53	0.84
Father's first reported occupation < professional/managerial	1.16	1.01	0.98	0.89	3.00***	1.12	1.48
Mother's first reported education < tertiary	1.36	1.24	1.46	1.36	0.65	1.14	1.43
Mother's first reported occupation < professional/managerial	0.85	1.09	0.79	0.94	0.68	1.22	1.69
Parental mental health and substance use							
Cohort-reported parental mental illness	1.94**	1.20	1.16	2.12	1.58	2.20*	0.92
Cohort-reported parental substance use problem	2.25***	2.20**	1.14	2.22	2.25*	1.32	4.70***
Either parent smoked	1.19	1.39	1.23	1.20	0.83	0.90	1.48
Father ex or heavy drinker during adolescence	1.00	1.07	1.01	1.04	1.00	1.00	0.73
Mother ex or heavy drinker during adolescence	2.05	1.25	1.67	excl.	0.57	2.46	2.46
Social instability							
High household mobility	0.60	0.59	0.86	0.71	0.45	0.78	0.67
High school mobility	1.99**	1.75	1.74*	1.14	3.58***	0.82	1.56
Parental separation or divorce	1.94***	1.62*	1.49*	1.80*	1.31	2.73***	2.28***

***p < 0.01, **p < 0.05, *p < 0.10; HIE: high-intensity emotional abuse; LIE: low-intensity emotional abuse; MI: multiply imputed; WDV: witnessed domestic violence. All estimates were obtained by logistic regression, adjusting for every other variable except for those listed as 'excl.' (excluded because of zero cell counts in some imputations) with multiple imputation of missing values.

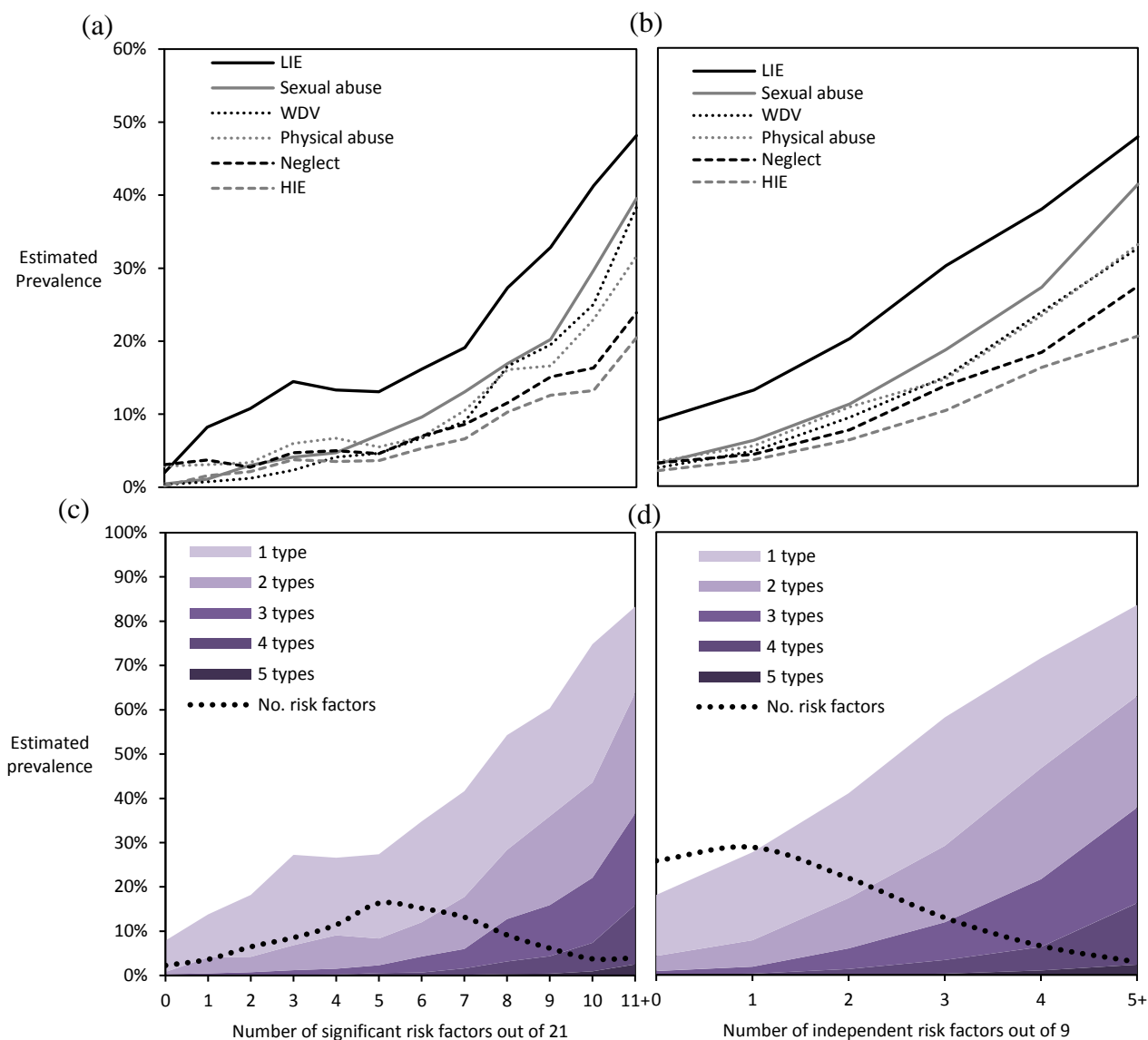


Figure 1 Cumulative risk of child maltreatment by number of risk factors

[Caption] HIE: high-intensity emotional abuse; LIE: low-intensity emotional abuse; WDV: witnessed domestic violence. Panels (a) and (c) illustrate the risk of child maltreatment by count of the 21 significant risk factors from column 2 of Table 3 (4 indicators of child health, 3 demographic factors, 7 economic factors, 5 indicators of parental mental health and substance use, and 2 indicators of social instability). Panels (b) and (d) illustrate the risk of child maltreatment by count of 9 independent risk factors identified in column 1 of Table 4 (1 indicator of child health, 2 demographic factors, 2 economic factors, 2 indicators of parental mental health and substance use, 2 indicators of social instability).

Table S 1 Risk factors for emotional maltreatment (restricted definition)

Risk factor	Odds ratio for maltreatment			
	Unadjusted	Models 1-5	Model 6	Model 7
Economic factors				
At least 'somewhat' poor while growing up	1.94	1.35	1.14	1.18
At least 2 points of parental unemployment	3.60***	3.02**	2.71*	2.94**
Family did not own home by age 7	2.19	1.37	1.38	1.46
Father's first reported education < diploma	1.17	0.76	0.77	0.84
Father's first reported occupation < professional/managerial	1.43	0.95	1.00	0.94
Mother's first reported education < diploma	2.26	1.49	1.61	1.75
Mother's first reported occupation < professional/managerial	2.44*	1.75	1.61	1.66
Social factors				
At least 10 house moves in childhood	1.62			
At least one parent from non-ES country	1.88	2.00	1.66	1.48
Father <22yo at birth				
Gender=male	0.92	0.91	1.08	1.05
More than 0.5 school moves per year	1.71			
More than 4 children in family	0.70	0.61	0.56	0.45
Mother <22yo at birth				
Parental separation or divorce	1.81	2.01	1.32	1.23
Parental mental health and substance use				
Either parent smoked	1.53	1.33	0.90	0.76
Father ex or heavy drinker during adolescence	2.06	1.67	1.45	2.14
Mother ex or heavy drinker during adolescence	1.01	0.68	0.74	0.68
Parental mental illness	1.37	1.16	0.98	0.89
Parental substance use problem	2.93*	2.37	1.94	2.99*

Risk factor	Odds ratio for maltreatment			
	Unadjusted	Models 1-5	Model 6	Model 7
Child health				
At least 2 investigated health problems by age 3	1.48	1.52		1.68
Below 3rd pc weight at 4-8 months				
Birthweight <3rd pc	0.82	0.98		0.61
Birthweight >97th pc	2.60	2.89		4.83**
Dysmature				
Gestational age <37 weeks				
Perinatal stress	0.72	0.72		0.71
Retrospective self-report of cognitive or behavioural problems while growing up	1.33	1.15		1.58
Retrospective self-report of physical health problems while growing up	2.50	2.49		2.16
Temperament				
Highest tertile of activity factor scale, 1983	1.13	1.23		1.39
Highest tertile of approach factor scale, 1983	1.16	1.14		0.79
Highest tertile of behaviour problems composite, 1983	1.45	1.50		1.43
Highest tertile of cooperation factor scale, 1983	0.56	0.45		0.43
Highest tertile of irritability factor scale, 1983	1.95	2.09*		2.41*
Highest tertile of rhythmicity factor scale, 1983	1.62	1.66		1.69
Mother's overall rating in 1983 = at least somewhat difficult	0.54	0.50		0.60
Nurse's overall rating more difficult	0.31	0.23		0.14**

Table S 2 Risk factors for any child maltreatment (with restricted definition of emotional maltreatment)

Risk factor	Odds ratio for maltreatment			
	Unadjusted	Models 1-5	Model 6	Model 7
Economic factors				
At least 'somewhat' poor while growing up	3.24***	2.61***	1.96**	2.11**
At least 2 points of parental unemployment	2.86***	2.19***	1.70*	1.86**
Family did not own home by age 7	1.57	0.88	0.88	0.84
Father's first reported education < diploma	1.38	0.70	0.73	0.75
Father's first reported occupation < professional/managerial	2.29***	1.97***	1.91**	1.99**
Mother's first reported education < diploma	1.88***	1.34	1.35	1.34
Mother's first reported occupation < professional/managerial	1.74**	1.05	1.14	1.16
Social factors				
At least 10 house moves in childhood	2.09			
At least one parent from non-ES country	1.33	1.57	1.52	1.67*
Father <22yo at birth	1.08	1.26	1.64	2.67
Gender=male	1.04	1.05	1.18	1.24
More than 0.5 school moves per year	3.24***			
More than 4 children in family	1.18	0.84	0.68	0.82
Mother <22yo at birth	1.22	1.07	0.58	0.41
Parental separation or divorce	3.69***	3.93***	2.74***	2.94***
Parental mental health and substance use				
Either parent smoked	1.80**	1.50	1.00	0.93
Father ex or heavy drinker during adolescence	2.13**	1.41	0.94	1.07
Mother ex or heavy drinker during adolescence	3.28*	2.46	2.72	3.41*
Parental mental illness	3.11***	2.67***	2.55***	2.30**
Parental substance use problem	3.50***	2.73**	2.06*	1.95

Risk factor	Odds ratio for maltreatment			
	Unadjusted	Models 1-5	Model 6	Model 7
Child health				
At least 2 investigated health problems by age 3	1.31	1.32		1.32
Below 3rd pc weight at 4-8 months	0.67	1.25		1.16
Birthweight <3rd pc	1.73	1.74		1.75
Birthweight >97th pc	0.65	0.74		0.64
Dysmature				
Gestational age <37 weeks	0.23*	0.22*		0.15*
Perinatal stress	0.73	0.80		0.78
Retrospective self-report of cognitive or behavioural problems while growing up	1.79**	1.72*		1.50
Retrospective self-report of physical health problems while growing up	1.73*	1.62		1.71
Temperament				
Highest tertile of activity factor scale, 1983	0.70	0.72		0.67
Highest tertile of approach factor scale, 1983	0.88	0.92		0.80
Highest tertile of behaviour problems composite, 1983	0.95	1.22		1.31
Highest tertile of cooperation factor scale, 1983	0.80	0.86		0.67
Highest tertile of irritability factor scale, 1983	0.94	1.06		0.86
Highest tertile of rhyimicity factor scale, 1983	0.82	0.86		0.78
Mother's overall rating in 1983 = at least somewhat difficult	0.52	0.57		0.71
Nurse's overall rating more difficult	0.69	0.84		0.59