



Tests of linear and nonlinear relations between cumulative contextual risk at birth and psychosocial problems during adolescence



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ABSTRACT

This study tested whether there are linear or nonlinear relations between prenatal/birth cumulative risk and psychosocial outcomes during adolescence. Participants ($n = 6963$) were taken from the Northern Finland Birth Cohort Study 1986. The majority of participants did not experience any contextual risk factors around the time of the target child's birth (58.1%). Even in this low-risk sample, cumulative contextual risk assessed around the time of birth was related to seven different psychosocial outcomes 16 years later. There was some evidence for nonlinear effects, but only for substance-related outcomes; however, the form of the association depended on how the cumulative risk index was calculated. Gender did not moderate the relation between cumulative risk and any of the adolescent psychosocial outcomes. Results highlight the potential value of using the cumulative risk framework for identifying children at birth who are at risk for a range of poor psychosocial outcomes during adolescence.

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Multiple contextual factors have been found consistently to increase the likelihood that children and adolescents will experience poor adjustment outcomes (Cicchetti, 2016). These ecological factors include economic disadvantage, teenage pregnancy, poor educational attainment by parents, and parent substance misuse (for overviews, see Day, Ji, DuBois, Silverthorn, & Flay, 2016; January et al., 2017). Contextual risk factors typically do not occur in isolation and thus children who experience one risk factor often are exposed to others (Evans, Li, & Sepanski Whipple, 2013; Felitti et al., 1998;

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McLaughlin et al., 2012). To understand the influence of contextual risk on child and adolescent psychosocial adjustment, it is important to consider the co-occurrence of adverse life circumstances (McLaughlin & Sheridan, 2016).

A continued challenge for researchers, practitioners, and policy makers interested in children's emotional and behavioral health is how best to conceptualize and quantify exposure to multiple contextual risk factors. One approach is the cumulative risk model (Rutter, 1979). This model posits that the number of risk factors rather than any specific one provides a useful metric for capturing children's level of risk for developing psychosocial difficulties. Individual risk factors in this approach are typically dichotomized and then summed to create a cumulative risk index. A recent review highlights key contributions of the cumulative risk model and describes several advantages of this approach compared to other methods of accounting for children's exposure to multiple risk factors including reduced measurement error, enhanced validity, and increased statistical power (Evans et al., 2013). This review also discussed several important unanswered questions. One fundamental issue that warrants further attention is determining whether the additive assumption underlying the cumulative risk model best represents the relation between cumulative risk and psychosocial problems.

Most cumulative risk research has examined a linear, additive model in which increases in the number of risk factors correspond to increases in the level of adjustment problems (Flouri, 2008). It is possible, however, that a threshold exists and the relation between the cumulative risk index and psychosocial outcomes changes after a certain number of risk factors. A nonlinear relation between cumulative risk and psychosocial outcomes indicates there is a threshold after which the relation changes. The change following a threshold could take one of two forms: (a) an accelerating effect in which lower levels of risk impact an outcome gradually up to a certain point (e.g., 4 risk factors) after which the negative impact on individuals intensifies or (b) a saturation effect in which the impact of cumulative risk on an outcome builds steadily to a plateau and levels off thereafter (Horan & Widom, 2015).

Evans et al. (2013) documented in their review whether each cumulative risk study provided support for a linear or nonlinear effect (see supplemental Table A in Evans et al., 2013). Although there are notable exceptions (e.g., Appleyard, Egeland, van Dulmen, & Sroufe, 2005; Horan & Widom, 2015), relatively few studies provided formal, direct tests of whether a linear or nonlinear relation best accounted for the cumulative risk-outcomes associations. For studies that did not conduct a direct test, Evans et al. used descriptive data to examine whether findings were consistent with a linear or nonlinear relation between cumulative risk and outcomes. They concluded that although caution should be taken when interpreting their observations "an equal proportion of CR studies found linear as opposed to nonlinear functions" (p. 1346). Thus, the evidence for a linear, additive compared to a nonlinear association between cumulative risk and psychosocial outcomes is mixed. Moreover, as discussed by Horan and Widom (2015), there is support for both the accelerating and saturation nonlinear effects. The current study was designed to help clarify the mixed results by directly testing linear and nonlinear relations between cumulative risk and psychosocial outcomes using a large representative sample with a longitudinal design spanning 16 years (see below for details).

Some cumulative risk studies have found linear and nonlinear effects for different outcomes within the same study (see supplemental Table A in Evans et al., 2013). For example, Horan and Widom (2015) found a quadratic relation between cumulative risk and years of education but a linear relation between cumulative risk and mental health problems and criminal arrests. Results like this highlight the need to not only directly examine linear and nonlinear effects but also consider multiple outcomes within the same study. Substance-related problems, delinquency, emotional difficulties, and academic problems are common during adolescence (Merikangas et al., 2010) and are related to a wide range of poor psychosocial outcomes later in life (Copeland et al., 2013). There continues to be a need to better understand risk factors that contribute to psychosocial difficulties among adolescents.

Another way to build on prior research examining the relation between cumulative risk and the psychosocial adjustment of youth is to identify factors that moderate the association. The review by Evans et al. (2013) highlighted several studies that found youth gender to be a moderator of the relation between cumulative risk and youth adjustment. Moreover, recent studies suggest there is a nuanced role for gender as a moderator of that relation. For example, Buehler and Gerard (2013) found that cumulative family risk was related to internalizing problems only for girls; whereas, the cumulative family risk index was related to externalizing problems only for boys. Horan and Widom (2015) found that gender moderated the relation between cumulative risk and educational attainment and adult criminal arrests but not anxiety and depressive symptoms. Wong et al. (2013) found a linear relation between cumulative risk and delinquency for boys and a quadratic relation for girls. Our own prior work using the same sample as the present study found that cumulative contextual risk at the prenatal/birth period was a significant positive predictor of adolescent risky sexual behavior for girls but not boys (Mason et al., 2016). Additional research is needed to better understand the seemingly complex role of gender in moderating the cumulative risk-youth outcomes relations.

A limitation of the cumulative risk literature is that risk factors are often assessed retrospectively and aggregated across developmental periods. The impact of cumulative risk on psychosocial adjustment can be better understood by considering risk at specific developmental periods. Prenatal and early childhood risk factors have been shown to have a particularly strong short- and long-term impact on emotional and behavioral outcomes (Shonkoff et al., 2012). Relatively few cumulative risk studies, however, have focused exclusively on prenatal risk factors (Evans et al., 2013). An advantage of investigating cumulative risk during the prenatal period is that associations with child and adolescent outcomes are not confounded with the context of risk. Thus, stronger conclusions can be made regarding the association between cumulative risk and outcomes.

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