



Risk and protective factors in early child development: Results from the All Our Babies (AOB) pregnancy cohort



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ABSTRACT

Background: Understanding factors that protect against early developmental delay among children who are experiencing adversity can inform prevention and early intervention strategies.

Aims: To identify risk factors for development delay at one year and protective factors for developmental delay in 'at risk' environments (poor maternal mental health and socio-demographic risk).

Methods and procedures: Data was analyzed from 3360 mother-child dyads who participated in the All Our Babies (AOB) pregnancy cohort. Participants completed four questionnaires spanning pregnancy to one year postpartum and provided access to medical records. Risk factors for developmental delay at age one were identified using bivariate methods and multivariable modeling. Protective factors for child development in 'at risk' family environments were identified using bivariate analyses.

Outcomes and results: At one year, 17% of children were developmentally delayed, defined as scoring in the monitoring zone on at least 2 of the 5 developmental domains of the Ages and Stages Questionnaire. Prenatal depression, preterm birth, low community engagement, and non-daily parent-child interaction increased the risk of delay. Protective factors for children in 'at risk' environments included relationship happiness, parenting self-efficacy, community engagement, higher social support, and daily parent-child interaction.

Conclusions and implications: The study results suggest that maternal and infant outcomes would be improved, even for vulnerable women, through identification and intervention to address poor mental health and through normalizing engagement with low cost, accessible community resources that can also support parent-child interaction.

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What this paper adds

This paper investigates risk factors for developmental delay at one year and protective factors for developmental delay in the contexts of poor maternal mental health and socio-demographic risk. Understanding the factors that protect against early development delay among children who are experiencing family risk, can inform prevention and early intervention strategies and result in better health outcomes for young children and less costly remedial interventions. At one year of age, 17% of infants were identified as delayed on two or more domains of development (communication, gross motor, fine motor, problem solving, personal/social). Children most at risk of delay were those who were born preterm, whose mothers experienced prenatal depression, whose mothers had low community engagement and who were not engaged in daily parent-child interaction including reading and playing imitation games. Among children exposed to poor maternal mental health and socio-demographic risk, the risk of delay is significantly reduced if mothers have higher parenting self-efficacy, relationship happiness, community engagement, higher social support and engage their children in daily reading and play. Low cost and accessible strategies, such as engagement in community resources (e.g. libraries, child care centres, recreation facilities), which target the protective factors identified in this study and others are feasible public health initiatives.

1. Introduction

One in six children experiences developmental problems at school entry (Kershaw et al., 2010), and recent Canadian trends indicate increasing prevalence rates across several provinces (Hertzman, 1998, 2009). Early developmental problems are associated with lower school readiness and poor school performance (Montes, Lotyczewski, Halterman, & Hightower, 2012; Romano, Babchishin, Pagani, & Kohen, 2010) and often co-occur with other concerns, affecting multiple domains of child health and development at once (Masten et al., 2004). Early intervention in the first three years of a child's life has been shown to be more effective than later remediation (Doyle, Harmon, Heckman, & Tremblay, 2009), but our ability to intervene is limited because we lack a comprehensive understanding of risk and protective factors. Risk factors identified in the literature that compromise children's development and the developing brain include biological risk factors (e.g., stunting, infections, anemia, IUGR, preterm birth), psychosocial risk factors (e.g., inadequate cognitive stimulation, exposure to violence, household dysfunction) and sociodemographic risk factors (e.g., poverty) (Aboud & Yousafzai, 2016; Bradley & Corwyn, 2002; Brooks-Gunn and Duncan, 1997; Grantham-McGregor et al., 2007; McCormick, Litt, Smith, & Zupancic, 2011; Moster, Lie, & Markestad, 2008; Walker et al., 2011). A number of studies have focused on risk factors for early delay in developing countries; as such, research is lacking that takes a population-based approach to examine risks in less vulnerable populations and developed countries.

Despite increasing interest in the early determinants of developmental delay (Maggi, Irwin, Siddiqi, & Hertzman, 2010), research in this area has tended to focus on single factors such as socioeconomic status or parenting, with less attention paid to protective factors and the accumulation of risk factors, including poor maternal mental health. Mounting evidence suggests that trajectories leading to poor health outcomes are established early in life and are influenced by environmental adversities that occur in the prenatal, postnatal, and early childhood periods (Cote et al., 2009; Petitclerc & Tremblay, 2009). Factors that promote optimal child development that have been identified in the literature include quality child care, caregiver-child interaction, maternal education, social support, and breastfeeding (Burchinal, Roberts, Nabors, & Bryant, 1996; Kramer et al., 2008; Wang, Wang, & Huang, 2008); however, similar to the risk-factor literature, a number of protective factors have been examined in at-risk environments that may not generalize to the general population. A better understanding of factors that protect against early developmental delay among children who are experiencing adversity, experiencing family risk, or who are at risk for poor health outcomes can inform prevention and early intervention strategies that are better nuanced to address at-risk contexts that are more common.

With more than one in four women experiencing poor mental health from conception to one year postpartum (Andersson, Sundstrom-Poromaa, Wulff, Astrom, & Bixo, 2006; Kingston, Heaman, Fell, Dzakupasu, & Chalmers, 2012; Priest, Austin, Barnett, & Buist, 2008), identifying those with poor perinatal mental health for early intervention may modify this influence on child development with extensive population impact. Our previous work using a community based cohort (n=791) illustrates that the risk for developmental delay at age three is elevated if mothers had poor mental health in the prenatal and post-partum periods (Tough et al., 2008). This analysis revealed that if maternal wellbeing is satisfactory in the prenatal period, the absolute risk of speech and language delay could be reduced by at least 25%, regardless of socio-economic status. On this basis, annual costs of providing optimal remedial services for developmental delay among three year olds would be reduced by at least 25% if effective interventions occurred in the prenatal and postpartum periods (Tough et al., 2008). Further description of community-specific risk and protective factors that are related to early child development outcomes require studies with large, representative samples so that interventions can be evidence informed.

1.1. Present study

This study describes risk factors for early development delay at one year. In addition, a resilience analysis identifies the main factors that reduce the impact of poor maternal mental health and low socioeconomic status on early child development.

2. Methods

Data for this study were drawn from the All Our Babies (AOB) study, a community-based prospective pregnancy cohort that represents the medically low risk pregnant and parenting population in Calgary (n = 3360) (Gracie et al., 2010; McDonald et al., 2013). Detailed descriptions of the AOB study design and methods have previously been described (Gracie et al., 2010; McDonald et al., 2013). In brief, Women were recruited during pregnancy using a community based multi-method recruitment strategy, involving primary health care offices providing prenatal care, the public health laboratory service (Calgary Laboratory Service) and community posters. Recruitment began in May 2008 and was completed in December 2010. Women were eligible to participate in the AOB study if they were less than 24 weeks and six days gestation at the time of enrolment, they were 18 years of age or older, they lived in the greater Calgary area and they were able to complete the written questionnaires in English. Women were excluded from the AOB study if they planned to move outside the greater Calgary area during their pregnancy. Participants were asked to complete three questionnaires, at study intake, between 34 and 36 weeks gestation and at four months postpartum and to provide the research team with access to their obstetrical and birth records. Participants who agreed to be contacted for future research were asked to complete a follow up questionnaire when their child was one year old.

2.1. Ethics

This study was approved by the Conjoint Health Research Ethics Board of the Faculty of Medicine at the University of Calgary. Participants provided consent at the time of recruitment and were provided copies of the consent form for their records.

2.2. Data collection

The AOB questionnaires were developed with input from health care providers, epidemiologists and community program experts. Standardized measures were included as part of the questionnaires when available. Questions were created specifically for the study when standardized items or previously developed items were not suitable.

2.2.1. Main outcome: child development

The main outcome, the child's development status at one year of age, was measured using the Ages and Stages Questionnaire (ASQ) (Squires, Twombly, Bricker, & Potter, 2009). The ASQ is a commonly used, parent completed, assessment tool in clinical and research practice to screen for developmental delay in five domains of child development including communication, gross motor, fine motor, problem solving and personal social. The risk category of each domain was defined as scoring one standard deviation below the mean of the ASQ normative data, which corresponds to falling in at least the 'monitoring zone' and potentially the 'referral zone' as per the ASQ scoring algorithm (Squires et al., 2009). An overall composite measure of child development was derived from and defined as scoring 'at risk' in at least two of the five domains on the ASQ. This operationalization provided an adequate sample size to examine global delay and aligned with proportions of 12–16% reported in the literature (Oberklaid & Efron, 2005; Rydz et al., 2006).

2.2.2. Main exposures: maternal mental health risk and socio-demographic risk

As per previous research that examined risk categories for poor child outcomes at school entry and middle childhood (Cabaj, McDonald, & Tough, 2014; Tough, Siever, Benzie, Leew, & Johnston, 2010; Tough et al., 2008), maternal mental health risk was defined as having at least two of the following: a history of abuse, a history of a mental health disorder, depression during pregnancy or anxiety during pregnancy. Socio-demographic risk was defined as having at least one of: young age (<25 years) at delivery, low education (no post secondary education), low family income (<\$80,000 per year), single marital status (single, separated, divorced or widowed), new Canadian (lived in Canada for < five years) or food insecurity (ran out of food and/or used a food bank).

2.2.3. Independent variables

The risk and protective factors for child development considered in the present study are described in Table one. Psychosocial health variables assessed using standardized measures included depression measured by the EPDS (Cox, Holden, & Sagovsky, 1987), anxiety measured by the SSAI (Spielberger, 1989), stress measured by the Perceived Stress Scale (PSS) (Cohen, Kamarck, & Mermelstein, 1983), social support measured by the Medical Outcomes Study Social Support Survey (MOS-SSS) (Sherbourne & Stewart, 1991) and optimism measured by the Life-Orientation Test-Revised (LOT-R) (Scheier, Carver, & Bridges, 1994). The Parenting Morale Index (PMI) (Trute & Hiebert-Murphy, 2005) was used to assess parenting morale and the Parental Cognitions and Conduct Toward the Infant (PACOTIS) (Boivin et al., 2005) was used to measure parenting self-efficacy.

2.3. Data analysis

Descriptive statistics, including frequencies and proportions were used to describe the sample, to determine the proportions of women experiencing poor mental health and the proportion of children with developmental delay at one year of age.

An initial bivariate analysis was conducted to identify risk factors for delayed child development (at risk in at least two domains on the ASQ). Associations were assessed using Pearson's Chi-square test or Fisher's exact test when expected cell counts were fewer than five. Multivariable logistic regression modeling was conducted to identify the independent risk factors most strongly associated with delayed development. A manual stepwise approach was used to build a final, parsimonious predictive model, with blocks of variables being added in sequential steps from non modifiable to potentially modifiable factors in the following order, (1) socio-demographic and life history events, (2) pregnancy and birth outcome variables, (3) child outcomes, and (4) postpartum and parenting variables (Table 1). Odds ratios (OR) with 95% confidence intervals (CI) were calculated. Statistical significance was set at $p < 0.05$ for both the bivariate analysis and multivariable model building.

A resilience analysis was conducted to identify factors related to positive child development in the context of family risk. Extremes of delay were compared: children with the lowest risk (no delay on any domain on the ASQ) were compared to children at higher risk (delayed on at least two of five domains on the ASQ). Chi-square tests were conducted to identify the factors related to positive child development in the two 'at risk' subgroups: (1) maternal mental health risk and (2) maternal socio-demographic risk.

3. Results

3.1. Socio-demographic characteristics

Table 2 describes the socio-demographic characteristics of the AOB cohort. The majority of AOB study participants were 25 years or older (91%), were living with a partner (94%), had post secondary education (89%) and had household incomes above \$80,000 (69%). Over 75 percent of participants were born in Canada (78%), described their ethnicity as White or Caucasian (79%), had lived in Canada for at least 5 years (90%) and listed English as the primary language spoken in their home (88%). Less than 10 percent of participants experienced food insecurity issues during the year prior to pregnancy, during pregnancy and during the year after they had their baby.

3.2. Maternal mental health characteristics

The proportion of participants reporting a history of a mental health disorder was 34% while 27% reported a history of abuse. The proportion of women with symptoms of depression during pregnancy based on having a score of 13 or higher on the EPDS, which is a validated cut-off for risk of major depression (Cox et al., 1987), was 8%. The proportion of women with symptoms of anxiety during pregnancy using the established cut off score of 40 or greater on the SSAI (Spielberger, 1989) was 17% (Table 3).

3.3. Child development

Based on maternal report on the ASQ, 6% of children had a communication delay, 23% had a gross motor delay, 10% had a fine motor delay, 17% had a problem solving delay, and 13% had a personal social delay (Table 4). Seventeen percent of children were delayed on at least two of the five domains of child development at one year of age. Among children with 2, 3, or 4 delays, the top three delayed domains were gross motor, problem solving, and personal social.

3.4. Risk factors for developmental delay at one year

Prenatal depression, preterm birth, low community engagement, and low parent-child interaction were the factors that increased the likelihood of delay in at least two domains of child development at one year of age (Table 5). In this model, low community engagement was operationalized as a mother who did not attend a recreation or fitness centre for herself, or access a baby class, or access drop-in childcare in the first postpartum year. Two variables that represented low parent-child interaction in this model were non-daily reading and non-daily imitation play by a parent at one year of age.

3.5. Resilience analysis: protective factors that mitigate risk for developmental delay in the context of family risk

Protective factors examined included social support, postpartum depression, postpartum anxiety, optimism, parenting morale, parenting self-efficacy, relationship happiness, co-parenting agreement, health service utilization, child care environment and community resource utilization.

Approximately 20% of participants were classified in the maternal mental health risk group, defined as having at least two of the following: a history of abuse, a history of a mental health disorder, depression during pregnancy, or anxiety during

Table 1
Description of dependent and independent study variables.

Category (Dependent Variable)	Description	Scoring
Child development outcome	Child development status at one year of age based on scores from the Ages and Stages questionnaire across the five domains: communication, gross motor, fine motor, problem solving and personal social	Poor child development = scoring 'at risk' on 2 or more of the 5 domains; Not poor child development = scoring 'at risk' on 0 or 1 of the 5 domains
Category (Independent Variables)	Description	Scoring
Sociodemographic and Life History Events * at time of study intake	Maternal age at delivery	<35 years; ≥35 years
	Maternal education*	High school or less; Some post secondary
	Marital status*	Married, common law; Single, separated, divorced, widowed
	Gross Household Income at 1 year postpartum	≥\$80,000; <\$79,999
	Time in Canada*	Born in Canada or lived in Canada ≥5 years; Lived in Canada <5 years
	Primary language spoken*	English; Other
	Family history of development delay, e.g. speech or language delay, dyslexia	Yes; No
	History of abuse, e.g. physical, emotional, sexual, financial, neglect	Yes; No
	History of any mental health disorder, e.g. depression, anxiety, bipolar	Yes; No
	Parity	No previous live birth; ≥1 previous live birth
	Fertility assistance	Yes; No
	Drinking during pregnancy including before knowing about pregnancy	Yes; No
	Smoking during pregnancy including before knowing about pregnancy	Yes; No
Pregnancy and Birth Outcomes	Depression in the 2nd trimester, EPDS ≥13	Yes; No
	Anxiety in the 2nd trimester, SAI ≥40	Yes; No
	Stress in the 2nd trimester, PSS ≥20.3	Yes; No
	Low social support in 2nd trimester, MOS-SSS ≤69	Yes = Inadequate social support; No = Adequate social support
	Low optimism in the 3rd trimester, LOT-R ≤20th percentile	Yes = Low optimism; No = Adequate optimism
	Gestational age at delivery	<37 weeks = preterm; ≥37 weeks = term
	Birth weight	<2500 g = low birth weight; ≥2500 g = not low birth weight
	Sex of child	Male; Female
	Chronic PP depression, EPDS ≥13 at 4 & 12 months PP	Yes; No
	Chronic PP anxiety, SAI ≥40 at 4 & 12 months PP	Yes; No
	Chronic PP stress, PSS ≥20.3 at 4 & 12 months PP	Yes; No
	Low social support at 4 months PP, MOS ≤69	Yes = Low social support; No = High social support
	Postpartum and Parenting Variables	Low parenting morale at 4 months PP, PMI ≤20th percentile
Parenting self-efficacy at one year postpartum using 4 of the 6 self-efficacy questions from PACOTIS; uses an 11 point scale.		Higher score = Higher self-efficacy
Used the library or attended a story time		Yes; No
Used a learning resource: Calgary Learning Centre or family literacy program		Yes; No
Used a parenting resource: Parent Link Centre, parenting class, Families Matter program		Yes; No
Used a recreation, leisure or fitness centre for self		Yes; No
Used a recreation, leisure or fitness centre for a mother and baby program		Yes; No
Used a drop in childcare centre		Yes; No
Used at least 2 informal community resources: Mom & Tots group, church/spiritual institution, parenting book/magazine, internet parenting group, parenting TV show		Used ≥2; Used <2
Used at least 3 of the six types of community resources: library, parenting, learning, recreation, drop in childcare, informal		Used ≥3; Used <3
Child has been to a doctor or public health clinic for a well baby visit		Yes; No

Table 1 (Continued)

Category (Dependent Variable)	Description	Scoring
Child health outcomes	Child's immunizations are up to date ie, received their 2, 4, and 6 month immunizations by 12 month follow-up	Yes; No
	A parental leave was taken by either parent	Yes; No
	Mother returned to work or school at 12 month follow-up	Yes; No
	Child is in some non-parental childcare at 12 month follow-up	Yes; No
	Child is regularly exposed to a language other than English at 1 year	Yes; No
	Child is read to daily at 1 year	Yes; No
	An adult in the household plays imitation games with the child daily at 1 year	Yes; No
	Child has been diagnosed with a long-term condition by a health professional by 12 month follow-up	Yes; No
	Child has had at least one ear infection by 12 month follow-up	Yes; No

Table 2

Socio-demographic characteristics of the AOB participants.

Socio-demographic Characteristics (n = 3252–3360 ^a)	n (%)
Maternal Age	
19 years or younger 20 to 24 years 25 to 34 years 35 years or older	33 (1.0) 264 (8.0) 2344 (71.4) 642 (19.6)
Marital Status	
Married/Common Law Single/Separated/Divorced	3165 (94.4) 189 (5.6)
Maternal Education	
High school or less College/University/Trade Post graduate studies	370 (11.0) 2458 (73.2) 528 (15.7)
Total Household Income (before taxes)	
\$39,999 or less \$40,000 to \$79,999 \$80,000 or more	299 (9.2) 717 (22.0) 2236 (68.8)
Born in Canada	
Yes No	2628 (78.2) 732 (21.8)
Ethnicity	
White/Caucasian Other	2636 (78.6) 718 (21.4)
Primary language spoken at home	
English Other	2967 (88.3) 392 (11.7)
Food Security Experience (n = 3054–3357^a)	n (%)
Anyone in household receiving food from charitable agency in year prior to pregnancy during pregnancy year after they had their baby	85 (2.5) 70 (2.2) 52 (1.7)
Experienced a time that the food they bought did not last/didn't have money to get more in year prior to pregnancy during pregnancy year after they had their baby	299 (8.9) 184 (5.8) 166 (5.4)
Housing Security Experience (n = 3048–3352^a)	
It has been difficult to find stable housing in year prior to pregnancy in month prior to 4 month postpartum questionnaire	149 (4.5) 62 (2.0)
Have moved 3 or more times in 2 years prior to pregnancy since becoming pregnant with this baby	226 (6.8) 15 (0.5)

^a Denominator varies due to missing data for some variables.**Table 3**

Maternal mental health characteristics.

Mental Health Characteristics (n = 3150–3359 ^a)	n (%)
History of mental health disorder	
Yes No	1153 (34.3) 2206 (65.7)
History of abuse	
Yes No	854 (27.1) 2296 (72.9)
Depression during pregnancy (EPDS ≥ 13)	
Yes No	270 (8.1) 3076 (91.9)
Anxiety during pregnancy (SAI ≥ 40)	
Yes No	550 (17.0) 2692 (83.0)

^a Denominator varies due to missing data for some variables, EPDS = Edinburgh Postnatal Depression Scale, SAI = Spielberger Anxiety Inventory.

Table 4
Developmental delays at 1 year on the ASQ.

ASQ domain (n = 1271–1275 ^a)	n (%)
Delayed communication (ASQ communication ≤ 29.43)	
Delayed	70 (5.5)
Not delayed	1205 (94.5)
Delayed gross motor (ASQ gross motor ≤ 35.71)	
Delayed	288 (22.6)
Not delayed	986 (77.4)
Delayed fine motor (ASQ fine motor ≤ 43.36)	
Delayed	128 (10.0)
Not delayed	1146 (90.0)
Delayed problem solving (ASQ problem solving ≤ 38.16)	
Delayed	221 (17.4)
Not delayed	1050 (82.6)
Delayed personal social development (ASQ personal social ≤ 33.73)	
Delayed	170 (13.4)
Not delayed	1103 (86.6)
Number of delayed domains (categorical)	
0	725 (57.0)
1	321 (25.3)
2	155 (12.2)
3	42 (3.3)
4	21 (1.7)
5	7 (0.6)
Number of delayed domains (dichotomous)	
0–1	1046 (82.3)
≥ 2	225 (17.7)

^a Denominator varies due to missing data for some variables, ASQ = Ages and Stages Questionnaire.

Table 5
Logistic regression model of significant risk factors for delayed child development.

Factor	Adjusted Odds Ratio (95% CI)	p-value
Depression during pregnancy (EPDS ≥ 13)	1.78 (1.01–3.13)	0.046
Preterm birth (<37 weeks)	2.32 (1.37–3.95)	0.002
Low community engagement factors		
Mother did not attend a local recreation, fitness or leisure centre for a mother & baby class/program in first postpartum year	1.79 (1.30–2.45)	<0.001
Mother did not use a drop-in childcare centre in first postpartum year	2.35 (1.15–4.81)	0.02
Low parent-child interaction factors		
Child is not read to daily at one year of age	1.77 (1.28–2.45)	0.001
An adult does not play imitation games with child daily at 1 year of age	1.66 (1.08–2.56)	0.02

Table 6
Protective factors for age appropriate child development among mothers with poor mental health.

Protective Factor	No Developmental Delay ^a (n = 134) n (%)	Development Delay ^a (n = 49) n (%)	p-value
Feeling happy in their relationship with their partner at one year	114 (89.8)	33 (75.0)	0.015
Higher parenting self-efficacy at 12 month follow-up (PACOTIS) mean (sd)	33.0 (4.4)	31.4 (4.5)	0.034
Attended a recreation, leisure, or fitness centre for a mother and baby class/program during first postpartum year	70 (54.3)	15 (31.9)	0.009
Playing imitation games with child daily at 1 year of age	118 (88.1)	35 (71.4)	0.007

^a No delay = 0 delays in all 5 domains; Delayed = child delayed in 2 or more domains.

pregnancy. Factors that were protective against delayed child development in this group included having higher parenting self-efficacy and feeling happy in their relationship with their partner when their child was 12 months of age. Additional factors that were protective included attending a recreation or fitness centre during the first postpartum year for a mother and baby program and playing imitation games with their child on a daily basis at one year of age (Table 6).

Approximately 26% of women had at least one socio-demographic risk factor (<25 years of age at delivery, low education, low family income, single marital status, new Canadian/lived in Canada for <five years, or experienced food insecurity). Factors that were found to be protective against delayed child development among mothers in this family risk subgroup included having higher social support during pregnancy, higher parenting self-efficacy at 12 months, attending a fitness or recreation centre for herself or for a mother/baby program during the first postpartum year, utilizing a drop-in childcare facility during the first postpartum year and engaging with their child daily by reading or playing imitation games (Table 7).

Table 7
Protective factors for age appropriate child development among mothers with socio-demographic risk.

Protective Factor	No Developmental Delay ^a (n = 173) n (%)	Development Delay ^a (n = 64) n (%)	p-value
Higher social support in the second trimester MOS \geq 70	142 (84.0)	45 (70.3)	0.019
Higher parenting self-efficacy at 12 month follow-up (PACOTIS) mean (sd)	33.6 (3.9)	31.7 (4.4)	0.001
Community engagement factors			
Attended a drop in childcare centre in first postpartum year	12 (7.3)	0 (0.00)	0.039 ^b
Attended a recreation, leisure, or fitness centre for herself during first postpartum year	74 (45.1)	12 (19.7)	<0.001
Attended a recreation, leisure, or fitness centre for a mother and baby class/program during first postpartum year	81 (49.4)	11 (18.0)	<0.001
Parent-child interaction factors			
Child is read to daily at 1 year of age	115 (66.9)	25 (40.3)	<0.001
Playing imitation games with child daily at 12 months of age	157 (90.8)	49 (77.8)	0.008

^a No delay = 0 delays in all 5 domains; Delayed = child delayed in 2 or more domains.

^b Fisher's Exact Test was used.

4. Discussion

In a community based group of medically low risk women who are representative of new parents in an urban centre (McDonald et al., 2013), results suggest that key risk factors for delayed child development at 12 months included being born preterm, prenatal depression, low community engagement, and low parent-child interaction during the first postpartum year. Protective factors against delayed child development among families at risk included: interacting with their child daily (reading, imitation games), having higher parenting self-efficacy, relationship happiness, higher social support and community engagement including attending a recreation/fitness centre and attending drop-in childcare during their child's first year. These findings provide further evidence in support of the adverse influence of maternal mental health and socioeconomic deprivation on child development, and they refine the understanding about the benefits of low cost activities to mitigate risk, including community engagement and adult interaction (Deave, Heron, Evans, & Emond, 2008; Feldman et al., 2009; Herba et al., 2013; Jaffee, 2007; Nelson et al., 2014; Vanderbilt-Adriance et al., 2015).

Preterm birth (<37 weeks completed gestation) is a known risk factor for delayed child development (Aarnoudse-Moens, Oosterlaan, Duivenvoorden, van Goudoever, & Weisglas-Kuperus, 2011; Chyi, Lee, Hintz, Gould, & Sutcliffe, 2008; Gurka, LoCasale-Crouch, & Blackman, 2010; Jain, 2008; Johnson et al., 2009; Lindstrom, Lindblad, & Hjern, 2011; MacKay, Smith, Dobbie, & Pell, 2010; McCormick et al., 2011; Moster et al., 2008; Poulsen et al., 2013; Sansavini, Guarini, & Caselli, 2011; Yang, Platt, & Kramer, 2010), as confirmed in this analysis where delayed development was twice as likely for preterm infants, controlling for other risk factors. Of note, among both preterm and term infants, community engagement and parent child interaction significantly reduced the risk of developmental problems.

While postpartum depression is widely recognized as having a detrimental effect on child development (Avan, Richter, Ramchandani, Norris, & Stein, 2010; Grace, Evindar, & Stewart, 2003; Kingston, 2011; Murray & Cooper, 1997; University, 2009), prenatal depression has more recently been associated with early development problems (Deave et al., 2008; Tough et al., 2008). In this study, the prevalence of prenatal depression during the second trimester was 8% increasing the odds of early development delay by 78%. The prevalence of prenatal anxiety was 17% and the prevalence of prenatal stress was 22%; neither were independently associated with an increased risk for developmental delay. However, other research has identified the co-morbidity of these conditions, and their ability to predict post partum depression (McDonald et al., 2012). Consequently, identifying symptoms of prenatal depression, anxiety or stress and implementing supportive strategies may protect against adverse developmental infant outcomes, and improve maternal mental health (Deave et al., 2008).

Low community engagement, operationalized as no use of community facilities and drop-in child care, almost doubled the risk of a development delay. There is limited research specific to the protective effect of accessing these resources on child development, however, there is evidence that higher social support for mothers provides a protective effect against delayed development for children (Armstrong, Birnie-Lefcovitch, & Ungar, 2005; Cabaj et al., 2014; University, 2015). It is possible that the outcome of attending these community resources was improved support.

Previous research has operationalized low interaction as (1) children not read to daily and (2) non-daily imitation games played and demonstrated the relationship with sub-optimal development (University, 2012). This research builds on these findings but notes the additive effect of low community engagement. Strategies that facilitate both community engagement and assist parents with infant interaction skills may offer an optimal way of reducing the risk of poor outcomes, particularly among families at risk.

5. Conclusions

In summary, this research describes three levels of risk for adverse developmental outcomes that occur at the infant, individual and community level. Risks do not operate in isolation of one another and there is an opportunity to remediate risk through interventions that address multiple factors concurrently (Evans, Li, & Whipple, 2013). Although prediction and prevention of preterm birth are beyond the scope of this paper, these data suggest that maternal and infant outcomes would be improved, even for vulnerable women, through (a) identification and intervention to address poor mental health in the prenatal period, and (b) normalizing engagement with low cost, accessible community resources that can also support parental engagement in reading and playing imitation games.

Limitations of this study include using a screening tool to operationalize developmental delay versus clinical assessment. However, the ASQ is a widely used tool among both clinicians and researchers with established predictive and construct validity (Kerstjens et al., 2009). Furthermore, the risk and protective factors identified in this study support previous research on child development which has used a variety of assessment tools. In addition, the proportion of delay in our study (17%) mirrors that found in other studies and is in line with expectations for a population-based study (Oberklaid & Efron, 2005; Ryzd et al., 2006; Tough et al., 2008). In the resilience analysis for this study, we did not perform multivariable regression modeling. However, our analysis specifically identified protective factors that distinguished extreme levels of functioning when we compared children at high risk to those at no risk for developmental delay, and follows previous resilience analyses in other studies (Cabaj et al., 2014). In addition, examining protective factors in sub-groups of the sample limited our ability to perform multivariable modeling. Alternative approaches to examine resilience are warranted.

It is well established in the life-course epidemiological literature that early life events and experiences impact the development of later life health, social and economical outcomes (Anda et al., 2006; Chapman et al., 2004; Chartier, Walker, & Naimark, 2010; Patten et al., 2015). Decades of research supports the association between adversity experienced during early life, brain plasticity, and epigenetic and stress-response changes and developmental and long-term health problems activity (Hackman, Farah, & Meaney, 2010; McCrory, De Brito, & Viding, 2010; Monk, Spicer, & Champagne, 2012). Early intervention and prevention initiatives have consistently shown high return on investment (Doyle et al., 2009). Low-cost and accessible strategies, such as engagement in community resources, which target the protective factors identified by this study and others are feasible public health initiatives. “Whether it is considered an outcome, a process, or a capacity, the essence of resilience is a positive, adaptive response in the face of significant adversity” (University, 2015). In the present study, attending recreation centres and daily parent-child interaction were found to mitigate the risk of developmental delay in the context of risk. Similarly, ensuring high quality childcare is available and supporting families in their parenting efficacy would benefit children who are at risk to optimize their potential. At the same time, the importance of identifying women with prenatal symptoms of depression cannot be overstated; for both mitigating the harmful effects on development that depression during pregnancy can cause but also the negative impact of postpartum depression. An upstream approach in preventing, or at a minimum, managing postpartum depression so that the negative impact on a child’s development can be mitigated is essential. In addition, further research on the influence of trajectories of maternal mental health across the perinatal period and early childhood would be informative.

Although children born in industrialized countries, regardless of socioeconomic level, are remarkably similar, it does not take long before delays in development become a reality for some children (Hertzman & Williams, 2009) and these early life experiences have life long consequences. The findings from this study can provide support for both policy development and program initiatives at local, provincial, and national levels to mitigate the inequalities in development and optimize early child development. It is time the science-policy gap is narrowed and the advances in scientific knowledge translated into innovative strategies both in the public and private sectors that will both strengthen the protective factors and reduce (or lessen) the risk factors for early child development delay (Hertzman & Williams, 2009; University, 2015).

Conflict of interest

The authors declare that there are no conflicts of interest.

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