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The associations between biological and sociodemographic risks for developmental vulnerability in twins at age five: A population data linkage study in Western Australia.

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Manuscript

- **Title:** The associations between biological and sociodemographic risks for developmental
- vulnerability in twins at age five: A population data linkage study in Western Australia.

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39 23

- Main Body Word Count: 3,955 words
- **Abstract Word Count: 293 words**

Short Title: Developmental vulnerability in twins at age five

Abbreviations

- AEDC: Australian Early Development Census
- ARIA: Accessibility and Remoteness Index of Australia
- AUSEI06: Australian Socioeconomic Index 2006
- 56 33 DV1: Developmentally Vulnerable on one or more Australian Early Development Census domains
- 58 34 DV2: Developmentally Vulnerable on two or more Australian Early Development Census domains
- CI: Confidence Interval

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- 36 IRSD: Index of Relative Socioeconomic Disadvantage
- 37 MNS: Midwives Notifications System
- 38 OR: Odds Ratio
- 39 POBW: Proportion of Optimal Birthweight
- 40 WA: Western Australia
- 1 41
 - 42 Keywords (max of 5):
 - Twins, Australian Early Development Census, Child Development, Record Linkage.
- 6 44

- What is already known about this topic
- 46 Twin pregnancies are classified as high risk pregnancies and associated with higher rates of
- 47 pregnancy complications and adverse neonatal, perinatal and developmental outcomes, compared to
- 48 singleton pregnancies.
- 4 49
 - What this study adds
 - Twins are more likely to be classified as developmentally vulnerable in their first year of full-time
 - 52 school than singletons.
 - Both biological and sociodemographic risk factors are associated with increased odds of
 - developmental vulnerability for twins in their first year of full-time school.

Abstract

- Objective: To investigate the associations between prenatal and perinatal risk factors and
- developmental vulnerability in twins at age five.
- Design: Retrospective cohort study using bivariate and multivariate logistic regression to identify
- associations between risk factors and developmental vulnerability.
- Setting: Western Australia (WA), 2002-2015.
- Participants: 828 twin pairs born in WA with an Australian Early Development Census (AEDC)
- record from 2009, 2012 or 2015.
- 20 63 Main Outcome Measures: The AEDC is a national measure of child development across five
 - domains. Children with scores <10th percentile were classified as developmentally vulnerable
 - (DV1 for one or more domains, DV2 for two or more domains).
 - Results: In this population, 431 (26.0%) twins were classified as DV1 and 223 (14.1%) as DV2. In
 - the multivariable model, risk factors for DV1 were; maternal age (<20 years; OR 8.69, 95% CI 1.52
 - to 49.69), language other than English spoken at home by the child (OR 5.25, 95% CI 1.77 to
 - 15.56), male child (OR 5.25, 95% CI: 2.99 to 9.24), age younger than the reference category for the
 - study sample (≥5 years one month to <5 years 10 months) at time of AEDC completion (at time of
 - AEDC completion (OR 3.10, 95% CI: 1.44 to 6.69), and having a proportion of optimal birthweight
 - (POBW) less than the 15th centile (OR 2.04, 95% CI 1.05 to 3.97). Risk factors for DV2 were; male
 - child (OR 7.98, 95% CI: 3.49 to 6.67), age younger than the reference category (OR 4.89, 95% CI:
 - 1.77 to 13.48), an unmarried maternal marital status (OR 4.43, 95% CI: 1.08 to 18.25), and having a
 - POBW <15th of the study sample (OR 3.30, 95% CI: 1.33 to 8.21).
- Conclusion: Both biological and sociodemographic risk factors are associated with developmental 50 76
 - vulnerability in twins at five years of age.

Article Summary

Strengths and Limitations

Limitations:

Datasets did not include data on twin zygosity nor complications of pregnancy that are specific to multiple pregnancies (e.g., twin reversed arterial perfusion, twin-twin transfusion syndrome). However, complications of multiple gestations are captured in the 'other complications of pregnancy' variable used in this study.

Strengths:

- This is the first study of this scale (population-level sample of twins; N>1,600) to assess developmental vulnerabilities in an otherwise healthy sample of Australian twins, at the time of their first year of full-time school.
- The use of population-based cohort design; the use of complete twin pairs for analysis; and use of a population-based estimate of optimal fetal growth and twins who did not have developmental disabilities.

Introduction

The increased use of assisted reproductive technologies and increasing maternal age at conception have attributed to a significant increase in the number of multifetal pregnancies around the world.¹ Multifetal pregnancies are classified as high risk pregnancies and are associated with higher rates of pregnancy complications and adverse neonatal and perinatal outcomes, compared to singleton pregnancies.²⁻⁶ The majority of the literature assessing higher order pregnancies has focused primarily on birth outcomes, including preterm birth, ⁷ low birth weight, ³ and developmental disabilities such as cerebral palsy.8 Studies that have assessed longer-term developmental outcomes of twins have focused on developmental outcomes around the age of two years. 9 Such studies have reported that that twins had poorer performance, in comparison to singletons, on a range of domains including; communication, gross and fine motor skills, problem solving, personal-social skills, and language development. 10,11 Furthermore, most studies examining child development outcomes at school starting age have focused on singleton children, from a single family and have compared children across families. 12 There is a paucity of research on the developmental vulnerability of multifetal pregnancies such as twins, around the time that they commence formal education. Child development outcomes can vary significantly based on numerous factors including the child's personal characteristics, such as personal dispositions and abilities, social constructs and the environments, both intrauterine and extrauterine, in which they develop. 13-16 Twin studies, aiming to assess the association between genes and the environment have supported the notion that both genes and the environment can impact child development. 17-20 Yet, a number of studies have reported no significant differences in child development outcomes based on zygosity. 21-23 Twins are however, more likely to be classified as preterm²⁴ or low birth weight, and have fetal growth restriction.²⁵ Studies that have assessed cognitive and school performance outcomes at the age of five have reported that children who are born preterm, ²⁶⁻³³ with a low birth weight, ³⁴⁻³⁷ are small for gestational age, ^{38,39} and male ⁴⁰⁻⁴³ are more likely to have poorer developmental outcomes. Given the higher rates of pregnancy neonatal and perinatal adversities observed in twins in comparison to

singletons, twins are particularly at risk for developmental delays in the early childhood period. A

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study reported that twins scored lower than singletons in both the Verbal and Performance IQ domains of the Wechsler Preschool and Primary Scale of Intelligence, at the ages of four and five years.²² Likewise, twin studies have also reported sex differences, with girls scoring higher than boys at ages four and five years.²² Studies have reported that twins are more likely to have poorer neurodevelopmental outcomes compared to singletons, even after controlling for gestational age and birthweight.44 Furthermore, sociodemographic factors such as low socioeconomic status and low levels of parental education, have also been identified to adversely impact child development outcomes. 45-47 Results from twin studies assessing the impact of sociodemographic factors on development outcomes in twins have been mixed. A study of a twin sample from the Quebec Newborn Twin Study reported that the environmental factors shared by twins of the same family, were more significantly associated with early language skills and school readiness in twins at the age of five years, in comparison to genetic factors.²¹ Whilst another study reported that poorer early cognitive and noncognitive development of twins, at the ages of; 6, 12 and 18 months, was associated with biological factors including low birth weight, independently of environmental factors, such as socioeconomic status.³ Studies assessing both biological and sociodemographic factors and their impact on the longer-term child development of children born from multiple pregnancies remain sparse and the results of the existing studies are mixed.

The aim of this study was to examine the association between biological and sociodemographic risk factors and developmental vulnerability in twins in their first year of full-time school.

Methods

Data Sources and Study Population

Data Sources

This study used anonymised unit records from the Department of Health WA. Australian Early Development Census (AEDC) records were obtained for all available years (2009, 2012 and 2015).

Perinatal and birth related data were obtained for children born in WA from the Midwives

Notification System (MNS), which is statutory record of all births (still- or live-born) in WA with
either a birthweight >400 grams or a final gestational length of ≥20 weeks. Variables from MNS
were cross validated with corresponding records from WA Birth Registrations. WA Register for
Developmental Anomalies (WARDA) records were used to identify children who had a diagnosed
developmental disability between birth and age five years.

Study Population

The study population included all children born in WA with an AEDC record in either 2009, 2012 or 2015 (N=73,903). Children were excluded from the study if; 1) they were not from a twin birth (N=71,748), 2) they were identified by their teacher as having 'special-needs' based on a diagnosed physical and/or intellectual disability (N=123), 3) they were reported as having any birth defect in the WARDA datasets (N=119), 4) they had an AEDC score that was either incomplete or missing (N=22), or 5) their twin sibling was excluded based on the aforementioned exclusion criteria (N=235; Figure 1). The final study sample consisted of N=1,656 children; N=828 twin pairs. There were 252 opposite sex twin pairs and 576 same sex twin pairs (277 male and 299 female twin pairs).

Outcome Measure

The AEDC is a national census of early childhood development spanning five developmental domains; 1) Physical Health and Wellbeing, 2) Social Competence, 3) Emotional Maturity, 4) Language and Cognitive skills (school-based), and 5) Communication Skills and General Knowledge. The AEDC is conducted every three years, with the first national data collection conducted in 2009. Children with scores <10th percentile in a given domain are classified as 'developmentally vulnerable.' AEDC cut-off scores are based on the first national AEDC data collection in 2009 and apply to all AEDC data collections. Domain scores for children with special needs are not included in the AEDC results. Two outcomes measures were used; developmentally

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vulnerable one or more AEDC domains (DV1) and developmentally vulnerable two or more AEDC domains (DV2).

Risk Variables

Maternal Variables

Maternal age and marital status at child's birth were obtained from the MNS and Birth Registrations. Maternal occupation at birth was obtained from Birth Registrations data and converted to a four-digit standard code using the Australian and New Zealand Standard Classification of Occupations. These codes were then assigned a value ranging from 0-100 using the Australian Socioeconomic Index 2006 (AUSEI06). All Low AUSEI06 values are representative of low-status occupations and high values represent high-status occupations. The distribution of values of AUSEI06 were then divided into five groups; [0,20], (20, 40], (40, 60], (60,80] and (80,100]. An AUSEI06 value of zero were assigned to records if occupation was reported as 'unemployed', 'stay at home parent' or 'pensioner.' For records where maternal occupation was not stated, an AUSEI06 value was not assigned and these cases were reported as missing.

Pregnancy and Birth Variables

We included several binary pregnancy and birth variables to indicate either the presence or absence; of fertility treatments, smoking during pregnancy, pre-eclampsia, gestational diabetes, threatened abortion, threatened pre-term labour, antepartum haemorrhage (APH), placenta praevia, placental abruption, fetal distress, cephalopelvic disproportion, prolapsed cord, precipitate delivery, post-partum haemorrhage (PPH), intubation status, early preterm birth (<34 weeks of gestational age), and time to Spontaneous Respiration (TSR); with a TSR of ≥2 minutes forming the 'at risk' group and five-minute Apgar score; with a five-minute Apgar score of <7 forming the 'at risk' group.

The proportion of optimal birthweight (POBW) is a measure of fetal growth and is defined as birth weight divided by expected birth weight, in the absence of pathologic risk factors. This measure also accounts for non-pathologic determinants of growth, including gestational age, birth order, sex of the child and maternal height⁴⁹ and has been validated against ultrasound measurements.⁵⁰ We

derived a binary proxy for fetal growth restriction as POBW <15th centile, which corresponded to an observed birth weight less than 75.75% of that expected.⁹

We derived a general category for other pregnancy related complications (not elsewhere stated; such as urinary tract infection, pre-labour rupture of membranes) for all records. As records may have multiple pregnancy related complications, all records that had a complication that was not elsewhere stated in this study or had multiple complications of which at least one complication was not elsewhere stated in this study, formed the 'at risk' group for this variable.

Child Variables

Sex and ethnicity of child was obtained from the MNS and Birth Registrations. Age at the time of AEDC completion and language other than English spoken at home were obtained from the AEDC. Age of children at the time of AEDC completion ranged between; \geq 3 years 10 months to <6 years 10 months, with a mean of age category of, \geq 5 years one month to 5 years 10 months. To balance frequencies, the age of children at the time of AEDC completion was categorised into three groups; 1) \geq 3 years 10 months to <5 years and one month, 2) \geq 5 years one month to <5 years 10 months (reference category) and 3) \geq 5 years 10 months to <6 years 10 months.

The total number of siblings were derived as the number of live births to each mother prior to the year that the cohort child had the AEDC conducted. Siblings from the twin pregnancy and siblings who died within the neonatal period (i.e. mode of separation post-birth from the hospital was death) were excluded in the calculations for total number of siblings.

Sociodemographic Variables

The Index of Relative Socioeconomic Disadvantage (IRSD)¹⁹ was calculated using the residential address at the time of birth. ISRD is derived from Australian Census data and reflects area-level disadvantage through variables such as low household income, low educational attainment and high levels of unemployment. Geographical areas are given a score from 1 (most disadvantaged) to 5 (most advantaged). Due to smaller cohort numbers in the more disadvantaged areas, these five

variables were collapsed into two groups; most disadvantaged quintile (i.e. ISRD quintile 1) and greater than the most disadvantaged quintile (i.e. ISRD quintiles 2-5).

Statistical Modelling

For each risk variable, the 'least risk' category (e.g. not early preterm birth) was used as the reference category (Table 1). To estimate the risk of a child being classified as DV1 and DV2, a generalised linear mixed model with a logit link function was used with a random intercept for each twin pair. A total of 30 maternal, pregnancy, birth, child and sociodemographic risk variables were considered for the multivariate models. For DV1, DV2, and each of the five AEDC domains, 24 risk variables were included in the multivariate models; six risks variables were excluded from multivariable analysis due to the prevalence being too small (total N<40 for a given category). The variables excluded were; 1) placenta praevia, 2) placental abruption, 3) cephalopelvic disproportion, 4) prolapsed cord, 5) precipitate delivery and 6) a five-minute Apgar score of <7. Odds ratios (OR) and the associated 95% confidence intervals (CIs) were estimated for both unadjusted and adjusted models. All analyses were undertaken using PROC GLIMMIX in SAS version 9.4 for Windows. ⁵¹

Results

Prevalence of developmental vulnerability in twins

A total of 431 (26.0%) twins were classified as DV1 (Table 1). Of the 28 maternal, pregnancy and birth, child and sociodemographic risk variables considered in the multivariate models, five variables had a statistically significant association with an increased risk of a twin being classified as DV1. In order of decreasing magnitude of associated risk, the ORs were; maternal age of 20 years or younger at time of twins' birth (OR 8.69, 95% CI 1.52 to 49.69), child speaks language other than English at home (OR 5.25, 95% CI 1.77 to 15.56), male twins (OR 5.25, 95% CI: 2.99 to 9.24), child age younger than the reference category for the study sample (≥5 years one month to 5 years 7 months) at time of AEDC completion (OR 3.10, 95% CI: 1.44 to 6.69), and POBW <15th percentile (OR 2.04, 95% CI 1.05 to 3.97).

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- A total of 223 (14.1%) twins were classified as DV2 (Table 2). Of the 24 maternal, pregnancy and birth, child and sociodemographic risk variables considered in the adjusted models, four variables had a statistically significant association with an increased risk of a twin being classified as DV2. Risk factors for DV2 were, in order of decreasing magnitude; male twins (OR 7.98, 95% CI 3.49 to 8.25), child age younger than the reference category at time of AEDC completion (OR 4.89, 95% CI: 1.77 to 13.48), unmarried maternal marital status (OR 4.43, 95% CI 1.08 to 18.25), and POBW <15th percentile (OR 3.30, 95% CI 1.33 to 8.21).
- Associations with domain-specific developmental vulnerability
- A total of, 188 (11.4%) children were classified as developmentally vulnerable for the domains of:

 Physical Health and Wellbeing; 151 (9.1%) for Social Competence; 147 (8.9%) for Emotional

 Maturity; 195 (11.8%) for Language and Cognitive Skills (school-based); and 200 (12.0%) for

 Communication Skills and General Knowledge (Supplementary Tables 1-5, respectively). These
 - results were broadly consistent with the findings for the aggregate measures of developmental
 - vulnerability (DV1 and DV2).

Discussion

This study examined the associations between biological and sociodemographic risk factors and developmental vulnerability in twins in their first year of full-time school. To our knowledge, our study is the first of this scale (population-level sample of twins; N>1,600) to report an elevated prevalence of developmental vulnerabilities, in comparison to singletons, in an otherwise healthy sample twins, at the time of their first year of full-time school. We found that the percentage of twins classified as developmentally vulnerable was higher than the percentage of children classified as developmentally vulnerable in the WA general population. In the WA twin population, 26.0% of twins were classified as DV1 and 14.1% as DV2 across the 2009, 2012 and 2015 AEDC cycles. In the general WA population, which includes twins and higher order multiples, 23.0% of children were classified as DV1 and 11.3% of children were classified as DV2, across these AEDC cycles. A large cohort study of 99,530 singleton children from New South Wales reported that 20.8% were

classified as DV1 across the 2009 and 2012 AEDC cycles.⁵³ Thus, we found that twins are at an

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elevated risk of developmental vulnerability relative to a general population of children in the state of Western Australia and in a singleton population in New South Wales. This is consistent with findings from a study of 142 twin pairs from the Louisville Twin Study, that reported twins scored lower than singletons in both the Verbal and Performance IQ domains of the Wechsler Preschool and Primary Scale of Intelligence at both four and five years of age.²² As our results were obtained from a sample of twins without any diagnosed developmental disabilities, the higher prevalence rates of twins being classified as DV1 and DV2 observed in our study, when compared to the general Australian population, suggests that healthy twins are more likely to be classified as developmental vulnerable on AEDC domains at school starting age when compared to their singleton counterparts. The biological factors associated with developmental vulnerability in twins were; male sex, fetal growth restriction, and younger chronological age at the time of AEDC completion. These results are in line with singleton studies^{40,54} which have reported that male children are more likely to be classified as developmentally vulnerable in their first year of full-time school, in comparison to female children. A study conducted in South Australia of 13,827 children, of which 3.4% where twins, also reported that male twins were more likely to be classified as DV2, when compared to female twins, however this finding was not statistically significant.⁵⁵ The Louisville Twin Study also reported sex differences, with females scoring higher than males at ages four and five years, however, scores tended to converge at six years of age.²² We also reported that twins younger than the reference category for this sample were more likely to be classified as developmentally vulnerable in their first year of full-time school. A study of 840 Canadian five-year old twins, aiming to assess the genetic and environmental factors influencing school readiness, reported that in the preliminary models age was positively correlated with the spatial recognition, numbers, and the letters components of the Lollipop test. ⁵⁶ Furthermore, a recent discussion paper identified the need for further research into assess the effects of delaying

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school entry for twins⁵⁷ thus, highlighting that further research is required to better elucidate if delaying school entry is beneficial for both short-term and long-term academic outcomes in twins. The sociodemographic risk factors associated with developmental vulnerability in twins included maternal age and unmarried marital status at the time of twins' birth, the child speaking a language other than English, and age at the time of AEDC completion. These results are supported by the South Australian study, that examined a range of variables also included in our study. 55 This study reported that maternal age and marital status were associated with an increased risk of children being classified as DV2 on the AEDC.⁵⁵ Furthermore, the South Australian study reported that maternal and paternal occupation, parity and smoking during pregnancy were also associated with an increased risk of children being classified as DV2.55 In our study we observed an increased but insignificant association between these risk variables and twins being classified as either DV1 or DV2. An interesting finding from our study was that speaking a language other than English at home was associated with an increased risk for twins being classified as DV1. Previous studies have reported that approximately a fifth of Australian children are bilingual,⁵⁸ and the prevalence of twins speaking a language other than English at home in our study were in line with these results. Results from a study of an Australia wide study of 261,147 children, singletons and multiples, from the 2009 AEDC cycle reported that bilingual children proficient in English have been reported to had

that approximately a fifth of Australian children are bilingual,⁵⁸ and the prevalence of twins speaking a language other than English at home in our study were in line with these results. Results from a study of an Australia wide study of 261,147 children, singletons and multiples, from the 2009 AEDC cycle reported that bilingual children proficient in English have been reported to had equal or slightly lower odds of being classed as DV1 when compared to their English-speaking background peers.⁵⁸ However, unlike our study, this study⁵⁸ did not report differences in developmental vulnerability based on plurality. Additionally, a Canadian study examining the school readiness profiles of 95,537 children in British Columbia⁵⁹ reported that bilingualism was associated with positive social, emotional and cognitive development, as measured by the Early Development Index.⁴³ Differences in results may be attributed to the fact bilingualism may be a risk factor for twins however, it may not be a significant risk factor in a general population sample. Furthermore, differences in the prevalence rates of particular language groups in WA is likely to be

different to those that are prevalent in British Colombia and the difference in findings between the Canadian study and our results may be attributable to this fact. Our findings have some accord with a cohort study examining the associations between biological and sociodemographic risk factors on late language emergency in 473 twins pairs at the age of two years. 9 Taylor et al. reported that the risk factors for late language emergence in twins, without developmental disabilities, include fetal growth restriction.⁹ Interestingly, our study also identified fetal growth restriction as a risk factor for developmental vulnerability at age five, suggesting that the biological implications of a suboptimal intrauterine environment may be persist beyond infancy and into early childhood in twins who did not have diagnosed developmental disabilities. In contrast to our study, the Taylor et al. twin sample excluded twins with exposure to languages other than English. Their study found that sociodemographic risk factors (low maternal education, socioeconomic area disadvantage) were not associated with late language emergence at age two years. A subsequent study of the twins at ages four years and six years reported that higher maternal education and older maternal age showed positive effects on language and non-verbal phenotypes.⁶ Our results suggest that sociodemographic factors including, maternal age and marital status at time of twins' birth, and the child speaking a language other than English at home are also associated with an increased risk of developmental vulnerability at age five. ⁹ The differences in findings between this study and our study suggest that sociodemographic characteristics may play a more significant role as risk variables at age five years compared to at the age of two years. This notion is supported by a study of a twin sample from the Quebec Newborn Twin Study, which reported that environmental factors, such as socioeconomic status, rather than genetic factors were attributable to the predictive association observed between early language skills and school readiness, as measured by the Lollipop Test, in twins 63-months of age. 21 However, further research is required to better elucidate the impact and interplay of biological and sociodemographic risk variables at different stages of development in twins.

Studies assessing twin-singleton differences often control for or select for factors such as prematurity, low birth weight, or parental socioeconomic status our study draws attention to adverse effect of risk factors such as POBW and maternal marital status on child development outcomes at age five. 54,60,61 An Australian cohort study of 1,922 children from the Northern Territory using linked administrative data, reported an increased, but non-significant, risk of twins being classified as DV1 on the AEDC, after controlling for a range of biological and sociodemographic variables used in our study including; sex, 5-minute Apgar score <7, area remoteness, ethnicity, child speaks a language other than English at home and maternal age at time of child's birth.⁵⁴ Although this study gave consideration to plurality as a risk factor for developmental vulnerability, it did not aim to assess the association between a comprehensive set of biological and sociodemographic risk factors. A Canadian study of 5-year old twins reported that shared environmental factors substantially accounted for cognitive school readiness (as measured by the Lollipop Test) as compared to genetic effects.⁵⁶ Likewise other studies have also reported that a range of family factors, which would be assumed to be shared by both twins, such as family income, maternal occupation, and employment status are associated with cognitive school readiness. 62,63 Further studies in this area are required as the extent and nature of the risk factors associated with developmental vulnerability at age five in twins remain not well-established. Preventative intervention studies have reported that programs designed to improve school readiness and high quality early childhood education and care, are effective for at-risk populations and can have significant long-term results. ^{64,65} The higher prevalence rates of DV1 and DV2 in twins observed in this study are indicative of the fact that twins form an at-risk group in terms of developmental vulnerability at the time at which children commence full-time school. Therefore, it is pertinent for those working in the early childhood education sector and for parents to be aware of the developmental vulnerabilities present in twins at the age at which children begin full-time school. In Australia, there has been call to provide increased quantity and quality of support service

and resources are required for twins and their families due to increased vulnerability⁵⁷ and the results of our study highlight this need.

Conclusions

Both biological and sociodemographic risk factors are associated with developmental vulnerability at the age of five. In particular, the results draw attention to the notion that prenatal and more significantly perinatal risk factors and sociodemographic environments in which twins are raised can impact developmental levels in early childhood.



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Patient and Public Involvement:

No patients were involved in the development of the research question or the outcome measures, or in the development of the plans for the design or implementation of the study.

Ethics Approval:

Ethics approval for this study was granted by the Western Australian Department of Health Human Research Ethics Committee (2016/51) and the University of Western Australia Human Research Ethics Committee (RA/4/20/4776).

Declaration of interests:

The authors declare that they have no competing interests, no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

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Author Contributions:

All authors contributed to study inception, design, interpretation of the results and writing of the paper and manuscript revisions. GKD did the literature review, data analysis and wrote the first draft of the paper. All authors contributed to the interpretation of the results and writing of the paper and all authors approved the final manuscript.

Data Sharing:

The linked administrative data are owned by the government departments who approved the linkage and use of the data for this study. Use of the study data is restricted to named researchers. The current Human Research Ethics Committee approvals were obtained for public sharing and presentation of data on group level only, meaning the data used in this study cannot be shared by the authors. Collaborative research may be conducted according to the ethical requirements and relevant privacy legislations. Potential collaborators should contact author GP with their expression of interest. The steps involved in seeking permission for linkage and use of the data used in this study are the same for all researchers.

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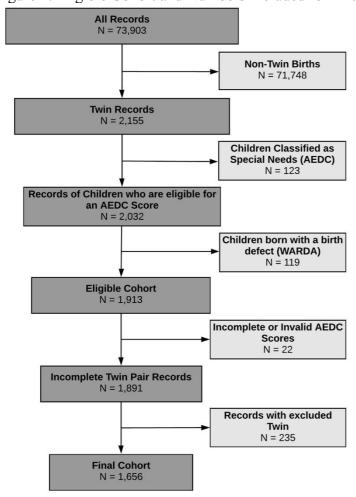
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Figures & Tables: Total 1 Figure & 2 Tables

Figure 1. Eligible Cohort and Numbers Included for Analyses.



AEDC = Australian Early Development Census. WARDA= Western Australian Register of Developmental Anomalies.

Table 1. Risk factors for children who are developmentally vulnerable on one or more AEDC domains (DV1).

domains (DV1).		I NDV4	Diversity -	NA. Jaio en de la la
Characterist:	DV1	NDV1	Bivariate	Multivariable
Characteristic	(N=431)	(N=1,225)	OD [050/ 01]	(N=1,352)
No. to	N (%)	N (%)	OR [95% CI]	aOR [95% CI]
Maternal Age at Time of Child's Birth				
≤20 years	48 (11.14)	34 (2.78)	26.92 [6.82-106.31]***	8.69 [1.52-49.69]*
21-25 years	69 (16.01)	135 (11.02)	2.96 [1.15-7.62]	2.16 [0.75-6.16]
26-30 years	101 (23.43)	333 (27.18)	1.00 [referent]	1.00 [referent]
31-35 years	133 (30.86)	465 (37.96)	0.91 [0.44-1.88]	1.14 [0.49-2.63]
36-40 years	61 (14.15)	229 (18.69)	0.81 [0.34-1.95]	1.14 [0.49-2.03]
>40 years	19 (4.41)	29 (2.37)	4.77 [0.89-25.52]	3.74 [0.51-27.53]
Marital Status	19 (4.41)	29 (2.37)	4.77 [0.03-23.32]	3.74 [0.31-27.33]
Married (inc. de facto)	357 (82.83)	1,123 (91.67)	1.00 [referent]	1.00 [referent]
All Other	72 (16.71)	98 (8.00)	5.99 [2.43-14.75]***	1.95 [0.65-5.85]
Unavailable	2 (0.46)	4 (0.33)	5.33 [2.43-14.75]	1.93 [0.03-3.63]
Occupational Status Scale at Tim				
0-20	122 (28.31)	187 (15.27)	7.97 [3.08-20.66]***	2.41 [0.76-7.64]
>20-40	119 (27.61)	268 (21.88)	3.74 [1.53-9.14]**	2.52 [0.90-7.11]
>40-60	71 (16.47)	338 (27.59)	0.85 [0.34-2.09]	0.67 [0.24-1.86]
>60-80	35 (8.12)	164 (13.39)	0.90 [0.30-2.64]	0.72 [0.20-2.54]
>80-100	54 (12.53)	236 (19.27)	1.00 [referent]	1.00 [referent]
Unavailable	30 (6.96)	32 (2.61)	1.00 [referent]	1.00 [referent]
Pregnancy & Birth	30 (0.90)	32 (2.01)		
Fertility Treatments				
No	377 (87.47)	1,011 (82.53)	1.00 [referent]	1.00 [referent]
Yes	54 (12.53)	214 (17.47)	0.43 [0.19-0.97]	0.78 [0.29-2.06]
Smoking Status During Pregnance		214 (17.47)	0.43 [0.13-0.37]	0.76 [0.25-2.00]
No	339 (78.65)	1,079 (88.08)	1.00 [referent]	1.00 [referent]
Yes	92 (21.35)	146 (11.92)	4.31 [1.95-9.53]***	0.91 [0.35-2.37]
Pre-eclampsia	32 (21.33)	140 (11.52)	4.51 [1.55 5.55]	0.51 [0.55 2.57]
No No	375 (87.01)	1,085 (88.57)	1.00 [referent]	1.00 [referent]
Yes	56 (12.99)	140 (11.43)	1.40 [0.59-3.34]	1.91 [0.71-5.17]
Gestational Diabetes	1 30 (±2.33)	1 (11.73)	1 2. 10 [0.00 0.04]	1 2.52 [5.71 5.17]
No No	402 (93.27)	1,152 (94.04)	1.00 [referent]	1.00 [referent]
Yes	29 (6.73)	73 (5.96)	1.30 [0.40-4.22]	1.16 [0.33-4.09]
Threatened Abortion	1 = 3 (0.7.5)	, , , , , , , , , , , , , , , , , , , ,	1 2.00 [0.10 1122]	1 2.20 [0.00 1.00]
No	416 (96.52)	1,156 (94.37)	1.00 [referent]	1.00 [referent]
Yes	15 (3.48)	69 (5.63)	0.36 [0.09-1.45]	0.19 [0.03-1.13]
Other Pregnancy Related Compli		1 (35)	1 []	1 [2]
No	125 (29.00)	451 (36.82)	1.00 [referent]	1.00 [referent]
Yes	306 (71.00)	774 (63.18)	2.08 [1.12-3.85]*	1.79 [0.84-3.80]
Threatened Preterm Labour	1 - (/	()		
No	376 (87.24)	1,088 (88.82)	1.00 [referent]	1.00 [referent]
Yes	55 (12.76)	137 (11.18)	1.34 [0.55-3.24]	0.78 [0.29-2.10]
APH		- /		
No	411 (95.36)	1,187 (96.90)	1.00 [referent]	1.00 [referent]
Yes	20 (4.64)	38 (3.10)	2.38 [0.53-10.73]	0.68 [0.12-3.97]
Placenta Praevia	, , ,	. , ,		
No	429 (99.54)	1,217 (99.35)		
Yes	2 (0.46)	8 (0.65)		
Placental Abruption ^a	1 ()	- \ 7		
No	427 (99.07)	1,223 (99.84)		
-	.=. (55.57)	=,=== (55.5.7		

Yes	4 (0.93)	2 (0.16)		
Fetal Distress				
No	382 (88.63)	1,136 (92.73)	1.00 [referent]	1.00 [referent]
Yes	49 (11.37)	89 (7.27)	2.92 [1.13-7.58]*	2.00 [0.68-5.86]
Cephalopelvic Disproportion ^a				
No	431 (100.00)	1,221 (99.67)		
Yes	0 (0.00)	4 (0.33)		
Prolapsed Cord ^a				
No	428 (99.30)	1,215 (99.18)		
Yes	3 (0.70)	10 (0.82)		
Precipitate Delivery ^a				
No	424 (98.38)	1,206 (98.45)		
Yes	7 (1.62)	19 (1.55)		
PPH ≥500mls	•	•	•	•
No	281 (65.20)	918 (74.94)	1.00 [referent]	1.00 [referent]
Yes	150 (34.80)	307 (25.06)	2.59 [1.39-4.82]**	1.48 [0.71-3.07]
TSR ≥2mins			•	· · · · · · · · · · · · · · · · · · ·
No	364 (84.45)	1,060 (86.53)	1.00 [referent]	1.00 [referent]
Yes	67 (15.55)	165 (13.47)	1.06 [0.56-1.99]	0.50 [0.22-1.17]
Apgar 5-minutes <7 a		,		
No	425 (98.61)	1,198 (97.80)		
Yes	6 (1.39)	27 (2.20)		
Intubation		,	•	
No	353 (81.90)	1,198 (97.80)	1.00 [referent]	1.00 [referent]
Yes	78 (18.10)	27 (2.20)	1.36 [0.75-2.45]	1.41 [0.65-3.08]
Early Preterm Birth				
No	352 (81.67)	1,058 (86.37)	1.00 [referent]	1.00 [referent]
Yes	79 (18.33)	167 (13.63)	2.08 [0.94-4.56]	1.38 [0.56-3.38]
POBW <15 th Percentile	,			
No	305 (70.77)	926 (75.59)	1.00 [referent]	1.00 [referent]
Yes	81 (18.79)	136 (11.10)	2.09 [1.14-3.84]*	2.04 [1.05-3.97]*
Unavailable	45 (10.44)	163 (13.31)		
Parity		•		
0	150 (34.80)	512 (41.80)	1.00 [referent]	1.00 [referent]
1	154 (35.73)	429 (35.02)	1.62 [0.83-3.16]	1.93 [0.74-5.02]
≥2	127 (29.47)	284 (23.18)	2.50 [1.20-5.22]*	1.60 [0.43-5.98]
Child				
Sex				
Female	176 (40.84)	674 (55.02)	1.00 [referent]	1.00 [referent]
Male	255 (59.16)	551 (44.98)	4.44 [2.68-7.36]***	5.25 [2.99-9.24]***
Ethnicity				
Other	385 (89.33)	1,187 (96.90)	1.00 [referent]	1.00 [referent]
Indigenous Australian	46 (10.67)	38 (3.10)	16.98 [4.85-59.46]***	2.80 [0.53-14.80]
Child Speaks Language Other Than	n English at Hom	ne		
No	367 (85.15)	1,149 (93.80)	1.00 [referent]	1.00 [referent]
Yes	64 (14.85)	76 (6.20)	6.28 [2.48-15.90]***	5.25 [1.77-15.56]**
Age Category at Time of AEDC Cor	npletion ^b			
1	109 (25.29)	212 (17.31)	2.93 [1.45-5.90]**	3.10 [1.44-6.69]**
2	288 (66.82)	911 (74.37)	1.00 [referent]	1.00 [referent]
3	34 (7.89)	102 (8.33)	1.18 [0.43-3.27]	0.94 [0.29-3.06]
Total Number of Siblings				
1	119 (27.61)	389 (31.76)	1.00 [referent]	1.00 [referent]
2	160 (37.12)	494 (40.33)	1.15 [0.58-2.30]	0.59 [0.22-1.58]
3	74 (17.17)	240 (19.59)	1.04 [0.45-2.41]	0.41 [0.12-1.45]

>3	78 (18.10)	102 (8.33)	7.28 [2.73-19.45]***	2.61 [0.58-11.79]
Sociodemographic				
Index of Relative Socioeconomic D	isadvantage			
Lowest Quintile	327 (75.87)	1,046 (85.39)	3.55 [1.62-7.78]**	1.36 [0.55-3.37]
> Lowest Quintile	87 (20.19)	150 (12.24)	1.00 [referent]	1.00 [referent]
Unavailable	17 (3.94)	29 (2.37)		

^{*}p<0.05, **p<0.01, ***p<0.001

^a Excluded from multivariable analysis due to small N.

^b Age categories classified as; \geq 3 years 10 months to <5 years and one month, 2) \geq 5 years and one month to <5 years and 10 months (reference category), 3) \geq 5 years and 10 months to <6 years 10 months.

Table 2. Risk factors for children who are developmentally vulnerable on two or more AEDC domains (DV2).

uomains (DV2).	DV2	NDV2	Bivariate	Multivariable
Characteristic	(N=223)	(N=1,433)	Divariace	(N=1,352)
Citat acteristic	N (%)	N (%)	OR [95% CI]	aOR [95% CI]
Maternal	14 (70)	1N (/0)	OV [33/0 CI]	aON [33% CI]
Age at Time of Child's Birth				
≤20 years	31 (13.90)	51 (3.56)	21.86 [4.97-96.20]***	3.94 [0.48-32.25]
21-25 years	38 (17.04)	166 (11.58)	2.73 [0.89-8.31]	1.17 [0.31-4.35]
26-30 years	52 (23.32)	382 (26.66)	1.00 [referent]	1.00 [referent]
31-35 years	69 (30.94)	529 (36.92)	0.85 [0.35-2.06]	1.24 [0.40-3.90]
36-40 years	24 (10.76)	266 (18.56)	0.46 [0.15-1.42]	0.60 [0.14-2.55]
>40 years	9 (4.04)	39 (2.72)	2.35 [0.32-17.31]	0.76 [0.04-13.56]
Marital Status	1 2 (3.03)	1 33 (2.72)	1 2.55 [0.52 17.51]	[0.70 [0.0+ 10.00]
Married (inc. de facto)	172 (77.13)	1,308 (91.28)	1.00 [referent]	1.00 [referent]
All Other	49 (21.97)	121 (8.44)	9.91 [3.54-27.77]***	4.43 [1.08-18.21]*
Unavailable	2 (0.90)	4 (0.28)	2.02 [0.0 : 2777]	
Occupational Status Scale at Time	, ,	. (0.20)		
0-20	78 (34.98)	231 (16.12)	10.45 [3.23-33.77]***	3.26 [0.70-15.31]
>20-40	56 (25.11)	331 (23.10)	2.77 [0.91-8.44]	1.54 [0.37-6.40]
>40-60	31 (13.90)	378 (26.38)	0.66 [0.20-2.10]	0.45 [0.10-1.97]
>60-80	15 (6.73)	184 (12.84)	0.64 [0.16-2.64]	0.30 [0.04-2.02]
>80-100	28 (12.56)	262 (18.28)	1.00 [referent]	1.00 [referent]
Unavailable	15 (6.73)	47 (3.28)		
Pregnancy & Birth	2 (33)	. (2:25)		
Fertility Treatments		4		
No	200 (89.69)	1,188 (82.90)	1.00 [referent]	1.00 [referent]
Yes	23 (10.31)	245 (17.10)	0.35 [0.13-0.97]	0.67 [0.16-2.75]
Smoking Status During Pregnancy			-	•
No	166 (74.44)	1,252 (87.37)	1.00 [referent]	1.00 [referent]
Yes	57 (25.56)	181 (12.63)	5.83 [2.32-14.65]***	1.28 [0.37-4.43]
Pre-eclampsia				
No	195 (87.44)	1,265 (88.28)	1.00 [referent]	1.00 [referent]
Yes	28 (12.56)	168 (11.72)	1.25 [0.41-3.86]	2.70 [0.71-10.27]
Gestational Diabetes				
No	208 (93.27)	1,346 (93.93)	1.00 [referent]	1.00 [referent]
Yes	15 (6.73)	87 (6.07)	1.44 [0.32-6.42]	2.55 [0.51-12.76]
Threatened Abortion				
No	214 (95.96)	1,358 (94.77)	1.00 [referent]	1.00 [referent]
Yes	9 (4.04)	75 (5.23)	0.54 [0.10-2.94]	0.19 [0.02-2.57]
Other Pregnancy Related Complication				
No	57 (25.56)	519 (36.22)	1.00 [referent]	1.00 [referent]
Yes	166 (74.44)	914 (63.78)	2.64 [1.22-5.69]*	1.70 [0.59-4.85]
Threatened Preterm Labour		,		
No	191 (85.65)	1,273 (88.83)	1.00 [referent]	1.00 [referent]
Yes	32 (14.35)	160 (11.17)	2.04 [0.66-6.29]	0.77 [0.21-2.81]
АРН	T	,	1	T
No	209 (93.72)	1,389 (96.93)	1.00 [referent]	1.00 [referent]
Yes	14 (6.28)	44 (3.07)	5.96 [0.95-37.40]	1.42 [0.17-12.22]
Placenta Praevia ^a		•		
No	223 (100.00)	1,423 (99.30)		
Yes	0 (0.00)	10 (0.70)		
Placental Abruption ^a		•		
No	221 (99.10)	1,429 (99.72)		

Yes	2 (0.90)	4 (0.28)		
Fetal Distress				
No	195 (87.44)	1,323 (92.32)	1.00 [referent]	1.00 [referent]
Yes	28 (12.56)	110 (7.68)	3.03 [0.90-10.23]	1.56 [0.38-6.37]
Cephalopelvic Disproportion ^a				
No	223 (100.00)	1,429 (99.72)		
Yes	0 (0.00)	4 (0.28)		
Prolapsed Cord ^a				
No	220 (98.65)	1,423 (99.30)		
Yes	3 (1.35)	10 (0.70)		
Precipitate Delivery ^a				
No	219 (98.21)	1,411 (98.46)		
Yes	4 (1.79)	22 (1.54)		
PPH ≥500mls				
No	141 (63.23)	1,058 (73.83)	1.00 [referent]	1.00 [referent]
Yes	82 (36.77)	375 (26.17)	3.43 [1.49-7.94]**	1.48 [0.56-3.94]
TSR ≥2mins			-	
No	183 (82.06)	1,241 (86.60)	1.00 [referent]	1.00 [referent]
Yes	40 (17.94)	192 (13.40)	1.78 [0.81-3.89]	0.89 [0.30-2.65]
Apgar 5-minutes <7 a				
No	219 (98.21)	1,404 (97.98)		
Yes	4 (1.79)	29 (2.02)		
Intubation		•		
No	178 (79.82)	1,404 (97.98)	1.00 [referent]	1.00 [referent]
Yes	45 (20.18)	29 (2.02)	1.91 [0.90-4.05]	1.50 [0.53-4.24]
Early Preterm Birth				
No	172 (77.13)	1,238 (86.39)	1.00 [referent]	1.00 [referent]
Yes	51 (22.87)	195 (13.61)	4.18 [1.50-11.67]**	2.22 [0.69-7.19]
POBW <15 th Percentile				
No	162 (72.65)	1,069 (74.60)	1.00 [referent]	1.00 [referent]
Yes	42 (18.83)	175 (12.21)	2.72 [1.25-5.93]*	3.30 [1.33-8.21]*
Unavailable	19 (8.52)	189 (13.19)		
Parity				
0	79 (35.43)	583 (40.68)	1.00 [referent]	1.00 [referent]
1	73 (32.74)	510 (35.59)	1.18 [0.51-2.76]	1.00 [0.27-3.71]
≥2	71 (31.84)	340 (23.73)	2.66 [1.04-6.83]*	2.89 [0.48-17.44]
Child				
Sex				
Female	83 (37.22)	767 (53.52)	1.00 [referent]	1.00 [referent]
Male	140 (62.78)	666 (46.48)	5.42 [2.79-10.55]***	7.98 [3.49-18.25]***
Ethnicity				
Other	197 (88.34)	1,375 (95.95)	1.00 [referent]	1.00 [referent]
Indigenous Australian	26 (11.66)	58 (4.05)	11.00 [2.78-43.60]***	2.76 [0.37-20.58]
Child Speaks Language Other Than	English at Home			
No	192 (86.10)	1,324 (92.39)	1.00 [referent]	1.00 [referent]
Yes	31 (13.90)	109 (7.61)	3.19 [0.96-10.63]	3.94 [0.97-16.08]
Age Category at Time of AEDC Con	npletion			
1	66 (29.6)	255 (17.79)	4.11 [1.80-9.39]***	4.89 [1.77-13.48]**
2	142 (63.68)	1057 (73.76)	1.00 [referent]	1.00 [referent]
3	15 (6.73)	121 (8.44)	0.95 [0.26-3.46]	0.33 [0.06-1.97]
Total Number of Siblings				
1	58 (26.01)	450 (31.40)	1.00 [referent]	1.00 [referent]
2	84 (37.67)	570 (39.78)	1.35 [0.57-3.19]	1.12 [0.29-4.26]
3	38 (17.04)	276 (19.26)	1.14 [0.40-3.24]	0.41 [0.07-2.38]

>3	43 (19.28)	137 (9.56)	7.14 [2.24-22.72]***	2.25 [0.30-17.06]
Sociodemographic				
Index of Relative Socioeconomic D	isadvantage			
Lowest Quintile	175 (78.48)	1,198 (83.60)	2.14 [0.76-6.02]	0.57 [0.17-1.90]
> Lowest Quintile	39 (17.49)	198 (13.82)	1.00 [referent]	1.00 [referent]
Unavailable	9 (4.04)	37 (2.58)		

^{*}p<0.05, **p<0.01, ***p<0.001

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^a Excluded from multivariable analysis due to small N.

^b Age categories classified as; \geq 3 years 10 months to <5 years and one month, 2) \geq 5 years and one month to <5 years and 10 months (reference category), 3) \geq 5 years and 10 months to <6 years 10 months.

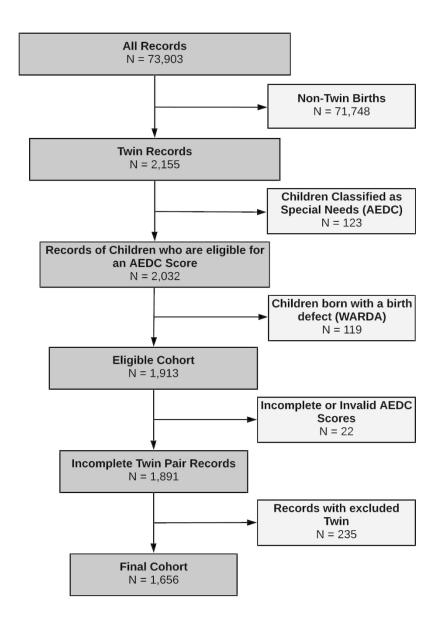


Figure 1. Eligible Cohort and Numbers Included for Analyses.

AEDC = Australian Early Development Census. WARDA= Western Australian Register of Developmental Anomalies.

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Supplementary Tables and Figures (Total: 5 tables, 0 figures)

Table 1. Risk Factors for Developmental Vulnerability on the Physical Health & Wellbeing Domain.

Table 1. Risk Factors for Deve				
	DV	NDV	Bivariate	Multivariable
Characteristic	(N=188)	(N=1,468)		(N=1,352)
	N (%)	N (%)	OR [95% CI]	aOR [95% CI]
Maternal				
Age at Time of Child's Birth	T	T	T	T
≤20 years	24 (12.77)	58 (3.95)	11.73 [2.52-54.66]***	3.87 [0.56-26.94]
21-25 years	26 (13.83)	178 (12.13)	1.33 [0.40-4.46]	1.17 [0.31-4.35]
26-30 years	48 (25.53)	386 (26.29)	1.00 [referent]	1.00 [referent]
31-35 years	61 (32.45)	537 (36.58)	0.88 [0.35-2.20]	1.10 [0.39-3.09]
36-40 years	22 (11.70)	268 (18.26)	0.47 [0.15-1.52]	0.42 [0.11-1.66]
>40 years	7 (3.72)	41 (2.79)	1.59 [0.19-13.59]	0.62 [0.04-9.67]
Marital Status	ı	ı	ı	1
Married (inc. de facto)	152 (80.85)	1,328 (90.46)	1.00 [referent]	1.00 [referent]
All Other	36 (19.15)	134 (9.13)	5.54 [1.87-16.35]**	2.21 [0.60-8.13]
Unavailable	0 (0.00)	6 (0.41)		
Occupational Status Scale at Time	of Child's Birth		_	
0-20	52 (27.66)	257 (17.51)	3.72 [1.18-11.71] [*]	0.53 [0.12-2.25]
>20-40	48 (25.53)	339 (23.09)	2.10 [0.69-6.34]	0.91 [0.26-3.26]
>40-60	33 (17.55)	376 (25.61)	0.81 [0.26-2.55]	0.43 [0.12-1.57]
>60-80	13 (6.91)	186 (12.67)	0.66 [0.16-2.65]	0.28 [0.05-1.50]
>80-100	25 (13.30)	265 (18.05)	1.00 [referent]	1.00 [referent]
Unavailable	17 (9.04)	45 (3.07)		
Pregnancy & Birth				
Fertility Treatments				
No	163 (86.70)	1,225 (83.45)	1.00 [referent]	1.00 [referent]
Yes	25 (13.30)	243 (16.55)	0.61 [0.21-1.75]	1.15 [0.33-3.93]
Smoking Status During Pregnancy	•		•	
No	134 (71.28)	1,284 (87.47)	1.00 [referent]	1.00 [referent]
Yes	54 (28.72)	184 (12.53)	7.19 [2.76-18.70]***	2.66 [0.87-8.14]
Pre-eclampsia	, ,		<u> </u>	
No	163 (86.70)	1,297 (88.35)	1.00 [referent]	1.00 [referent]
Yes	25 (13.30)	171 (11.65)	1.56 [0.46-5.24]	3.11 [0.94-10.34]
Gestational Diabetes	, ,	. ,	,	, ,
No	173 (92.02)	1,381 (94.07)	1.00 [referent]	1.00 [referent]
Yes	15 (7.98)	87 (5.93)	1.87 [0.36-9.87]	2.50 [0.56-11.24]
Threatened Abortion	(: := = /			
No	182 (96.81)	1,390 (94.69)	4.00 [1.00 [referent]
Yes			1 1.00 ireferenti	1 1.00
			1.00 [referent] 0.45 [0.07-2.71]	-
Utner Pregnancy Related Complica	6 (3.19)	78 (5.31)	0.45 [0.07-2.71]	0.37 [0.04-3.34]
Other Pregnancy Related Complication	6 (3.19) ntions	78 (5.31)	0.45 [0.07-2.71]	0.37 [0.04-3.34]
No	6 (3.19) ntions 51 (27.13)	78 (5.31) 525 (35.76)	0.45 [0.07-2.71] 1.00 [referent]	0.37 [0.04-3.34] 1.00 [referent]
No Yes	6 (3.19) ntions	78 (5.31)	0.45 [0.07-2.71]	0.37 [0.04-3.34]
No Yes Threatened Preterm Labour	6 (3.19) ations 51 (27.13) 137 (72.87)	78 (5.31) 525 (35.76) 943 (64.24)	0.45 [0.07-2.71] 1.00 [referent] 1.96 [0.87-4.42]	0.37 [0.04-3.34] 1.00 [referent] 1.76 [0.67-4.64]
No Yes Threatened Preterm Labour No	6 (3.19) ations 51 (27.13) 137 (72.87) 161 (85.64)	78 (5.31) 525 (35.76) 943 (64.24) 1,303 (88.76)	1.00 [referent] 1.96 [0.87-4.42] 1.00 [referent]	0.37 [0.04-3.34] 1.00 [referent] 1.76 [0.67-4.64] 1.00 [referent]
No Yes Threatened Preterm Labour No Yes	6 (3.19) ations 51 (27.13) 137 (72.87)	78 (5.31) 525 (35.76) 943 (64.24)	0.45 [0.07-2.71] 1.00 [referent] 1.96 [0.87-4.42]	0.37 [0.04-3.34] 1.00 [referent] 1.76 [0.67-4.64]
No Yes Threatened Preterm Labour No Yes APH	6 (3.19) ations 51 (27.13) 137 (72.87) 161 (85.64) 27 (14.36)	78 (5.31) 525 (35.76) 943 (64.24) 1,303 (88.76) 165 (11.24)	1.00 [referent] 1.96 [0.87-4.42] 1.00 [referent] 1.68 [0.49-5.81]	0.37 [0.04-3.34] 1.00 [referent] 1.76 [0.67-4.64] 1.00 [referent] 0.82 [0.25-2.76]
No Yes Threatened Preterm Labour No Yes APH No	6 (3.19) ations 51 (27.13) 137 (72.87) 161 (85.64) 27 (14.36) 178 (94.68)	78 (5.31) 525 (35.76) 943 (64.24) 1,303 (88.76) 165 (11.24) 1,420 (96.73)	1.00 [referent] 1.96 [0.87-4.42] 1.00 [referent] 1.68 [0.49-5.81] 1.00 [referent]	1.00 [referent] 1.76 [0.67-4.64] 1.00 [referent] 0.82 [0.25-2.76]
No Yes Threatened Preterm Labour No Yes APH No Yes	6 (3.19) ations 51 (27.13) 137 (72.87) 161 (85.64) 27 (14.36)	78 (5.31) 525 (35.76) 943 (64.24) 1,303 (88.76) 165 (11.24)	1.00 [referent] 1.96 [0.87-4.42] 1.00 [referent] 1.68 [0.49-5.81]	0.37 [0.04-3.34] 1.00 [referent] 1.76 [0.67-4.64] 1.00 [referent] 0.82 [0.25-2.76]
No Yes Threatened Preterm Labour No Yes APH No Yes Placenta Praevia a	6 (3.19) ations 51 (27.13) 137 (72.87) 161 (85.64) 27 (14.36) 178 (94.68) 10 (5.32)	78 (5.31) 525 (35.76) 943 (64.24) 1,303 (88.76) 165 (11.24) 1,420 (96.73) 48 (3.27)	1.00 [referent] 1.96 [0.87-4.42] 1.00 [referent] 1.68 [0.49-5.81] 1.00 [referent]	1.00 [referent] 1.76 [0.67-4.64] 1.00 [referent] 0.82 [0.25-2.76]
No Yes Threatened Preterm Labour No Yes APH No Yes Placenta Praevia a No	6 (3.19) ations 51 (27.13) 137 (72.87) 161 (85.64) 27 (14.36) 178 (94.68) 10 (5.32) 187 (99.47)	78 (5.31) 525 (35.76) 943 (64.24) 1,303 (88.76) 165 (11.24) 1,420 (96.73) 48 (3.27) 1,459 (99.39)	1.00 [referent] 1.96 [0.87-4.42] 1.00 [referent] 1.68 [0.49-5.81] 1.00 [referent]	1.00 [referent] 1.76 [0.67-4.64] 1.00 [referent] 0.82 [0.25-2.76]
No Yes Threatened Preterm Labour No Yes APH No Yes Placenta Praevia a No Yes	6 (3.19) ations 51 (27.13) 137 (72.87) 161 (85.64) 27 (14.36) 178 (94.68) 10 (5.32)	78 (5.31) 525 (35.76) 943 (64.24) 1,303 (88.76) 165 (11.24) 1,420 (96.73) 48 (3.27)	1.00 [referent] 1.96 [0.87-4.42] 1.00 [referent] 1.68 [0.49-5.81] 1.00 [referent]	1.00 [referent] 1.76 [0.67-4.64] 1.00 [referent] 0.82 [0.25-2.76]
No Yes Threatened Preterm Labour No Yes APH No Yes Placenta Praevia a No Yes Placental Abruption a	6 (3.19) ations 51 (27.13) 137 (72.87) 161 (85.64) 27 (14.36) 178 (94.68) 10 (5.32) 187 (99.47) 1 (0.53)	78 (5.31) 525 (35.76) 943 (64.24) 1,303 (88.76) 165 (11.24) 1,420 (96.73) 48 (3.27) 1,459 (99.39) 9 (0.61)	1.00 [referent] 1.96 [0.87-4.42] 1.00 [referent] 1.68 [0.49-5.81] 1.00 [referent]	1.00 [referent] 1.76 [0.67-4.64] 1.00 [referent] 0.82 [0.25-2.76]
No Yes Threatened Preterm Labour No Yes APH No Yes Placenta Praevia a No Yes	6 (3.19) ations 51 (27.13) 137 (72.87) 161 (85.64) 27 (14.36) 178 (94.68) 10 (5.32) 187 (99.47)	78 (5.31) 525 (35.76) 943 (64.24) 1,303 (88.76) 165 (11.24) 1,420 (96.73) 48 (3.27) 1,459 (99.39)	1.00 [referent] 1.96 [0.87-4.42] 1.00 [referent] 1.68 [0.49-5.81] 1.00 [referent]	1.00 [referent] 1.76 [0.67-4.64] 1.00 [referent] 0.82 [0.25-2.76]

No	162 (86.17)	1,356 (92.37)	1.00 [referent]	1.00 [referent]
Yes	26 (13.83)	112 (7.63)	4.89 [1.20-19.90]*	2.52 [0.70-9.05]
Cephalopelvic Disproportion ^a				
No	188 (100.00)	1,464 (99.73)		
Yes	0 (0.00)	4 (0.27)		
Prolapsed Cord ^a				
No	188 (100.00)	1,455 (99.11)		
Yes	0 (0.00)	13 (0.89)		
Precipitate Delivery ^a				
No	186 (98.94)	1,444 (98.37)		
Yes	2 (1.06)	24 (1.63)		
PPH ≥500mls				
No	124 (65.96)	1,075 (73.23)	1.00 [referent]	1.00 [referent]
Yes	64 (34.04)	393 (26.77)	2.16 [0.90-5.18]	0.86 [0.34-2.13]
TSR ≥2mins				
No	152 (80.85)	1,272 (86.65)	1.00 [referent]	1.00 [referent]
Yes	36 (19.15)	196 (13.35)	1.48 [0.64-3.44]	0.53 [0.19-1.49]
Apgar 5-minutes <7 a				
No	182 (96.81)	1,441 (98.16)		
Yes	6 (3.19)	27 (1.84)		
Intubation				
No	147 (78.19)	1,242 (84.60)	1.00 [referent]	1.00 [referent]
Yes	41 (21.81)	226 (15.40)	2.33 [1.03-5.28] [*]	1.85 [0.72-4.77]
Early Preterm Birth				
No	146 (77.66)	1,264 (86.1)	1.00 [referent]	1.00 [referent]
Yes	42 (22.34)	204 (13.9)	3.76 [1.21-11.68] [*]	2.21 [0.77-6.29]
POBW <15 th Percentile				
No	125 (66.49)	1,106 (75.34)	1.00 [referent]	1.00 [referent]
Yes	42 (22.34)	175 (11.92)	3.44 [1.53-7.74]**	2.71 [1.21-6.10] [*]
Unavailable	21 (11.17)	187 (12.74)		
Parity	1		T	1
0	67 (35.64)	595 (40.53)	1.00 [referent]	1.00 [referent]
1	65 (34.57)	518 (35.29)	1.18 [0.48-2.86]	1.28 [0.40-4.13]
≥2	56 (29.79)	355 (24.18)	1.81 [0.67-4.91]	1.52 [0.28-8.29]
Child				
Sex	T	T		T
Female	82 (43.62)	768 (52.32)	1.00 [referent]	1.00 [referent]
Male	106 (56.38)	700 (47.68)	2.50 [1.36-4.61]**	3.33 [1.65-6.71]***
Ethnicity	I	I		
Other	167 (88.83)	1,405 (95.71)	1.00 [referent]	1.00 [referent]
Indigenous Australian	21 (11.17)	63 (4.29)	12.56 [2.12-74.52]**	0.87 [0.13-5.91]
Child Speaks Language Other Than			1.001.6	1.001.6
No	159 (84.57)	1,357 (92.44)	1.00 [referent]	1.00 [referent]
Yes	29 (15.43)	111 (7.56)	4.62 [1.24-17.26]*	4.04 [1.13-14.47]*
Age Category at Time of AEDC Cor	1	274 (40.46)	0 =0 [4 00 = 40]*	2.05 [2.02.5.47]
1	50 (26.6)	271 (18.46)	2.76 [1.02-7.46]*	2.06 [0.82-5.17]
3	129 (68.62)	1,070 (72.89)	1.00 [referent]	1.00 [referent]
	9 (4.79)	127 (8.65)	0.44 [0.10-1.93]	0.19 [0.03-1.24]
Total Number of Siblings	E1 (27 12)	AE7 /21 12\	1 00 [referent]	1 00 [referent]
2	51 (27.13) 69 (36.70)	457 (31.13)	1.00 [referent] 1.10 [0.46-2.63]	1.00 [referent]
3	24 (12.77)	585 (39.85) 290 (19.75)	0.51 [0.16-1.57]	0.82 [0.25-2.69] 0.34 [0.07-1.77]
>3	44 (23.40)	136 (9.26)	8.32 [2.57-26.96]***	5.52 [0.83-36.72]
Sociodemographic		130 (3.20)	0.32 [2.37-20.30]	J.J2 [U.03-3U.72]
Index of Relative Socioeconomic D)icadvantaca			
Lowest Quintile	1	1,235 (84.13)	3.78 [1.17-12.22]*	1 68 [0 57 4 04]
LOWEST QUITTIE	138 (73.40)	1,233 (04.13)	3.70 [1.17-12.22]	1.68 [0.57-4.94]

> Lowest Quintile	40 (21.28)	197 (13.42)	1.00 [referent]	1.00 [referent]
Unavailable	10 (5.32)	36 (2.45)		

^{*}p<0.05, **p<0.01, ***p<0.001

^a Excluded from multivariable analysis due to small N.

affs \(\text{..ths to } < \) ^b Age categories classified as; ≥3 years 10 months to <5 years and one month, 2) ≥5 years and one month to <5 years and 10 months (reference category), 3) \geq 5 years and 10 months to <6 years 10 months.

Table 2. Risk Factors for Developmental Vulnerability on the Social Competence Domain.

Table 2. Risk Factors	for Developmental	Vulnerability on the	e Social Competenc	e Domain.
	DV	NDV	Bivariate	Multivariable
Characteristic	(N=151)	(N=1,505)		(N=1,352)
	N (%)	N (%)	OR [95% CI]	aOR [95% CI]
Maternal				
Age at Time of Child's B	irth			
≤20 years	21 (13.91)	61 (4.05)	11.00 [2.29-52.75]***	1.84 [0.23-14.81]
21-25 years	23 (15.23)	181 (12.03)	1.63 [0.48-5.54]	1.15 [0.28-4.76]
26-30 years	37 (24.50)	397 (26.38)	1.00 [referent]	1.00 [referent]
31-35 years	43 (28.48)	555 (36.88)	0.65 [0.25-1.71]	0.81 [0.26-2.52]
36-40 years	20 (13.25)	270 (17.94)	0.63 [0.20-2.05]	0.79 [0.19-3.24]
>40 years	7 (4.64)	41 (2.72)	2.45 [0.30-20.20]	0.35 [0.02-7.22]
Marital Status				
Married (inc. de facto)	113 (74.83)	1,367 (90.83)	1.00 [referent]	1.00 [referent]
All Other	36 (23.84)	134 (8.90)	9.65 [3.20-29.05]***	9.31 [2.34-37.13]**
Unavailable	2 (1.32)	4 (0.27)		
Occupational Status Sca	ale at Time of Child's Bi	rth		
0-20	50 (33.11)	259 (17.21)	3.32 [1.08-10.18]*	0.86 [0.20-3.76]
>20-40	38 (25.17)	349 (23.19)	1.21 [0.41-3.64]	0.52 [0.13-2.04]
>40-60	18 (11.92)	391 (25.98)	0.30 [0.09-1.01]	0.17 [0.04-0.75]
>60-80	11 (7.28)	188 (12.49)	0.38 [0.09-1.65]	0.26 [0.04-1.60]
>80-100	27 (17.88)	263 (17.48)	1.00 [referent]	1.00 [referent]
Unavailable	7 (4.64)	55 (3.65)		
Pregnancy & Birth				
Fertility Treatments				
No	132 (87.42)	1,256 (83.46)	1.00 [referent]	1.00 [referent]
Yes	19 (12.58)	249 (16.54)	0.54 [0.18-1.60]	1.32 [0.35-5.00]
Smoking Status During	Pregnancy			
No	116 (76.82)	1,302 (86.51)	1.00 [referent]	1.00 [referent]
Yes	35 (23.18)	203 (13.49)	3.70 [1.06-12.91]*	1.31 [0.38-4.57]
Pre-eclampsia				
No	134 (88.74)	1,326 (88.11)	1.00 [referent]	1.00 [referent]
Yes	17 (11.26)	179 (11.89)	0.98 [0.31-3.14]	2.03 [0.54-7.58]
Gestational Diabetes				
No	140 (92.72)	1,414 (93.95)	1.00 [referent]	1.00 [referent]
Yes	11 (7.28)	91 (6.05)	1.46 [0.32-6.60]	2.41 [0.48-12.17]
Threatened Abortion				
No	144 (95.36)	1,428 (94.88)	1.00 [referent]	1.00 [referent]
Yes	7 (4.64)	77 (5.12)	0.66 [0.11-4.10]	0.11 [0.01-2.11]
Other Pregnancy Relate	ed Complications			
No	38 (25.17)	538 (35.75)	1.00 [referent]	1.00 [referent]
Yes	113 (74.83)	967 (64.25)	2.15 [0.89-5.19]	2.05 [0.71-5.92]
Threatened Preterm Lal	bour	•		•
No	131 (86.75)	1,333 (88.57)	1.00 [referent]	1.00 [referent]
Yes	20 (13.25)	172 (11.43)	1.32 [0.42-4.17]	0.70 [0.19-2.61]
APH		•		•
No	142 (94.04)	1,456 (96.74)	1.00 [referent]	1.00 [referent]
Yes	9 (5.96)	49 (3.26)	3.74 [0.62-22.66]	2.17 [0.28-16.92]
Placenta Praevia ^a		, ,		
No	151 (100.00)	1,495 (99.34)		
Yes	0 (0.00)	10 (0.66)		
Placental Abruption ^a	. , ,	1 /		
No	149 (98.68)	1,501 (99.73)		
Yes	2 (1.32)	4 (0.27)		
Fetal Distress	1 (- 7	1 ()		
No	132 (87.42)	1,386 (92.09)	1.00 [referent]	1.00 [referent]
		_,555 (52.55)		

Yes	19 (12.58)	119 (7.91)	2.77 [0.81-9.50]	1.36 [0.33-5.69]
Cephalopelvic Dispropo	' '	(/		1 [0.00 0.00]
No	151 (100.00)	1,501 (99.73)		
Yes	0 (0.00)	4 (0.27)		
Prolapsed Cord ^a	0 (0.00)	1 (0.27)		
No	148 (98.01)	1,495 (99.34)		
Yes	3 (1.99)	10 (0.66)		
Precipitate Delivery ^a	3 (1.33)	10 (0.00)		
No	149 (98.68)	1,476 (98.07)		
Yes	2 (1.32)	29 (1.93)		
PPH ≥500mls	2 (1.02)	23 (2.33)		
No	96 (63.58)	1,103 (73.29)	1.00 [referent]	1.00 [referent]
Yes	55 (36.42)	402 (26.71)	2.61 [1.14-5.97]*	1.34 [0.51-3.53]
TSR ≥2mins	33 (30.12)	102 (20.71)		1.5 1 [0.51 5.55]
No	119 (78.81)	1,305 (86.71)	1.00 [referent]	1.00 [referent]
Yes	32 (21.19)	200 (13.29)	1.76 [0.80-3.89]	0.77 [0.26-2.34]
Apgar 5-minutes <7 a	32 (21.13)	200 (13.23)	1.70 [0.00 3.03]	0.77 [0.20 2.54]
No	147 (97.35)	1,476 (98.07)		
Yes	4 (2.65)	29 (1.93)		
Intubation	. (2.00)	25 (1.55)		
No	112 (74.17)	1,277 (84.85)	1.00 [referent]	1.00 [referent]
Yes	39 (25.83)	228 (15.15)	2.31 [1.00-5.33]	2.49 [0.87-7.15]
Early Preterm Birth	33 (23.03)	220 (13.13)	2.51 [1.00 5.55]	2.43 [0.07 7.13]
No	123 (81.46)	1,287 (85.51)	1.00 [referent]	1.00 [referent]
Yes	28 (18.54)	218 (14.49)	1.64 [0.59-4.57]	0.77 [0.23-2.57]
POBW <15 th Percentile	20 (10.54)	210 (14.43)	1.04 [0.33 4.37]	0.77 [0.23 2.37]
No	114 (75.5)	1,117 (74.22)	1.00 [referent]	1.00 [referent]
Yes	23 (15.23)	194 (12.89)	1.51 [0.65-3.54]	1.65 [0.63-4.31]
Unavailable	14 (9.27)	194 (12.89)	1.51 [0.05 5.54]	1.03 [0.03 4.31]
Parity	14 (3.27)	154 (12.05)		
0	58 (38.41)	604 (40.13)	1.00 [referent]	1.00 [referent]
1	49 (32.45)	534 (35.48)	1.06 [0.44-2.56]	0.83 [0.23-3.00]
≥2	44 (29.14)	367 (24.39)	1.73 [0.67-4.50]	1.84 [0.31-10.88]
Child	44 (23.14)	307 (24.33)	1.73 [0.07 4.30]	1.0+ [0.31 10.00]
Sex				
Female	51 (33.77)	799 (53.09)	1.00 [referent]	1.00 [referent]
Male	100 (66.23)	706 (46.91)	5.21 [2.58-10.52]***	5.42 [2.42-12.14]***
Ethnicity	100 (00.20)	700 (10.51)	0.22 [2.00 20.02]	, o [
Other	137 (90.73)	1,435 (95.35)	1.00 [referent]	1.00 [referent]
Indigenous Australian	14 (9.27)	70 (4.65)	3.96 [0.86-18.29]	2.74 [0.40-18.97]
Child Speaks Language (, ,	0.00 [0.00 20.20]	
No	139 (92.05)	1,377 (91.50)	1.00 [referent]	1.00 [referent]
Yes	12 (7.95)	128 (8.50)	0.67 [0.17-2.62]	1.02 [0.22-4.71]
Age Category at Time of	, ,	(5.55)	1 2.2. [2.2. 2.02]	
1	40 (26.49)	281 (18.67)	2.42 [0.98-5.94]	2.83 [1.04-7.66]*
2	98 (64.9)	1,101 (73.16)	1.00 [referent]	1.00 [referent]
3	13 (8.61)	123 (8.17)	1.73 [0.46-6.48]	0.59 [0.11-3.13]
Total Number of Sibling		- \		[0.20]
1	41 (27.15)	467 (31.03)	1.00 [referent]	1.00 [referent]
2	57 (37.75)	597 (39.67)	1.27 [0.50-3.23]	1.78 [0.46-6.81]
3	27 (17.88)	287 (19.07)	1.27 [0.41-3.91]	0.83 [0.14-4.80]
>3	26 (17.22)	154 (10.23)	4.06 [1.14-14.39]*	2.35 [0.30-18.43]
Sociodemographic	- \/			[5.65 25/10]
Index of Relative Socioe	conomic Disadvantage			
Lowest Quintile	118 (78.15)	1,255 (83.39)	1.67 [0.59-4.74]	0.67 [0.20-2.31]
> Lowest Quintile	26 (17.22)	211 (14.02)	1.00 [referent]	1.00 [referent]
2011030 Quilline	(1,.22)	(,02)	[2.00 [. 0.0.0.1.1]

Unavailable 7 (4.64) 39 (2.59)

p<0.05, **p<0.01, ***p<0.001

^a Excluded from multivariable analysis due to small N.

^b Age categories classified as; ≥3 years 10 months to <5 years and one month, 2) ≥5 years and one month to <5 years and 10 months (reference category), 3) \geq 5 years and 10 months to \leq 6 years 10 months.

Table 3. Risk Factors for Developmental Vulnerability on the Emotional Maturity Domain.

Table 3. Risk Factors:	for Development	al Vulnerability or	the Emotional Matur	rity Domain.
	DV	NDV	Bivariate	Multivariable
Characteristic	(N=147)	(N=1,509)		(N=1,352)
	N (%)	N (%)	OR [95% CI]	aOR [95% CI]
Maternal				
Age at Time of Child's Bi	rth			
≤20 years	22 (14.97)	60 (3.98)	7.09 [2.58-19.51]***	2.65 [0.67-10.48]
21-25 years	19 (12.93)	185 (12.26)	1.18 [0.50-2.78]	0.98 [0.36-2.70]
26-30 years	34 (23.13)	400 (26.51)	1.00 [referent]	1.00 [referent]
31-35 years	44 (29.93)	554 (36.71)	0.89 [0.46-1.71]	0.95 [0.43-2.11]
36-40 years	23 (15.65)	267 (17.69)	1.02 [0.47-2.23]	0.92 [0.35-2.43]
>40 years	5 (3.40)	43 (2.85)	1.32 [0.29-5.90]	0.42 [0.05-3.69]
Marital Status				
Married (inc. de facto)	111 (75.51)	1,369 (90.72)	1.00 [referent]	1.00 [referent]
All Other	34 (23.13)	136 (9.01)	4.58 [2.26-9.27]***	3.25 [1.28-8.27]*
Unavailable	2 (1.36)	4 (0.27)		
Occupational Status Scal	le at Time of Child's	Birth		
0-20	45 (30.61)	264 (17.50)	1.80 [0.85-3.82]	0.97 [0.36-2.64]
>20-40	34 (23.13)	353 (23.39)	0.88 [0.41-1.87]	0.60 [0.24-1.53]
>40-60	22 (14.97)	387 (25.65)	0.45 [0.20-1.02]	0.34 [0.13-0.90]
>60-80	11 (7.48)	188 (12.46)	0.49 [0.18-1.30]	0.23 [0.06-0.90]
>80-100	28 (19.05)	262 (17.36)	1.00 [referent]	1.00 [referent]
Unavailable	7 (4.76)	55 (3.64)		
Pregnancy & Birth				
Fertility Treatments				
No	126 (85.71)	1,262 (83.63)	1.00 [referent]	1.00 [referent]
Yes	21 (14.29)	247 (16.37)	0.81 [0.40-1.66]	1.10 [0.44-2.73]
Smoking Status During P	regnancy			
No	118 (80.27)	1,300 (86.15)	1.00 [referent]	1.00 [referent]
Yes	29 (19.73)	209 (13.85)	1.70 [0.86-3.36]	0.85 [0.34-2.11]
Pre-eclampsia	, ,			
No .	129 (87.76)	1,331 (88.20)	1.00 [referent]	1.00 [referent]
Yes	18 (12.24)	178 (11.80)	1.09 [0.50-2.40]	1.96 [0.79-4.86]
Gestational Diabetes	1 , ,	, , ,		
No	138 (93.88)	1,416 (93.84)	1.00 [referent]	1.00 [referent]
Yes	9 (6.12)	93 (6.16)	1.02 [0.35-2.97]	1.35 [0.43-4.28]
Threatened Abortion	, ,	, ,		
No	140 (95.24)	1,432 (94.90)	1.00 [referent]	1.00 [referent]
Yes	7 (4.76)	77 (5.10)	0.91 [0.28-3.03]	0.08 [0.01-1.03]
Other Pregnancy Related	` '	(/		
No	35 (23.81)	541 (35.85)	1.00 [referent]	1.00 [referent]
Yes	112 (76.19)	968 (64.15)	2.13 [1.20-3.80]*	1.87 [0.89-3.92]
Threatened Preterm Lab	• •	366 (325)		2.07 [0.00 0.02]
No	125 (85.03)	1,339 (88.73)	1.00 [referent]	1.00 [referent]
Yes	22 (14.97)	170 (11.27)	1.52 [0.72-3.25]	1.14 [0.48-2.69]
APH	(()	1 = - 0 (==/)	[5 = 0.20]	[00 2.00]
No	139 (94.56)	1,459 (96.69)	1.00 [referent]	1.00 [referent]
Yes	8 (5.44)	50 (3.31)	2.13 [0.62-7.31]	0.64 [0.13-3.20]
Placenta Praevia ^a	[0 (0.44)	1 30 (3.31)	[2.10 [0.02 /.01]	0.0 . [0.10 0.20]
No	146 (99.32)	1,500 (99.40)		
Yes	1 (0.68)	9 (0.60)		
Placental Abruption ^a	1 (0.00)	j 5 (0.00)		
No	145 (98.64)	1,505 (99.73)		
Yes	2 (1.36)	4 (0.27)		
	2 (1.30)	4 (U.Z/)		
Fetal Distress	120 /07 07\	1 200 (02 11)	1.00 [roforon+1	1.00 [noforcat]
No	128 (87.07)	1,390 (92.11)	1.00 [referent]	1.00 [referent]

Yes	19 (12.93)	119 (7.89)	1.95 [0.86-4.44]	1.02 [0.38-2.74]
Cephalopelvic Disproport	· '	, ,		•
No	147 (100.00)	1,505 (99.73)		
Yes	0 (0.00)	4 (0.27)		
Prolapsed Cord ^a	, ,	. , ,		<u> </u>
No	145 (98.64)	1,498 (99.27)		
Yes	2 (1.36)	11 (0.73)		
Precipitate Delivery ^a	()	(/		
No	146 (99.32)	1,484 (98.34)		
Yes	1 (0.68)	25 (1.66)		
PPH ≥500mls	1 (0.00)	23 (1.00)		
No	95 (64.63)	1,104 (73.16)	1.00 [referent]	1.00 [referent]
Yes	52 (35.37)	405 (26.84)	1.75 [1.01-3.05]*	1.00 [0.51-1.97]
TSR ≥2mins	32 (33.37)	403 (20.64)	1.75 [1.01-3.05]	1.00 [0.51-1.97]
	110 (00 05)	1 205 (06 40)	1 00 [vofovout]	1 00 [nofement]
No	119 (80.95)	1,305 (86.48)	1.00 [referent]	1.00 [referent]
Yes	28 (19.05)	204 (13.52)	1.69 [0.91-3.15]	1.12 [0.46-2.70]
Apgar 5-minutes <7 a	140/0-00	1 400 (00 ==)		
No	143 (97.28)	1,480 (98.08)		
Yes	4 (2.72)	29 (1.92)		
Intubation		T	T	T
No	114 (77.55)	1,275 (84.49)	1.00 [referent]	1.00 [referent]
Yes	33 (22.45)	234 (15.51)	1.78 [0.98-3.21]	1.44 [0.62-3.35]
Early Preterm Birth			_	_
No	119 (80.95)	1,291 (85.55)	1.00 [referent]	1.00 [referent]
Yes	28 (19.05)	218 (14.45)	1.51 [0.76-3.00]	1.01 [0.45-2.27]
POBW <15 th Percentile				
No	106 (72.11)	1,125 (74.55)	1.00 [referent]	1.00 [referent]
Yes	24 (16.33)	193 (12.79)	1.48 [0.76-2.87]	1.64 [0.79-3.41]
Unavailable	17 (11.56)	191 (12.66)		
Parity				
0	61 (41.5)	601 (39.83)	1.00 [referent]	1.00 [referent]
1	52 (35.37)	531 (35.19)	0.99 [0.55-1.78]	0.92 [0.39-2.20]
≥2	34 (23.13)	377 (24.98)	0.89 [0.46-1.72]	0.89 [0.25-3.14]
Child		, i		
Sex				
Female	32 (21.77)	818 (54.21)	1.00 [referent]	1.00 [referent]
Male	115 (78.23)	691 (45.79)	10.13 [4.94-20.79]***	9.63 [4.53-20.45]***
Ethnicity	1			
Other	131 (89.12)	1,441 (95.49)	1.00 [referent]	1.00 [referent]
Indigenous Australian	16 (10.88)	68 (4.51)	3.62 [1.36-9.62]*	5.91 [1.55-22.54]**
Child Speaks Language Of		, ,	0.02 [2.00 0.02]	0.01 [1.00 11.0.1]
No	135 (91.84)	1,381 (91.52)	1.00 [referent]	1.00 [referent]
Yes	12 (8.16)	128 (8.48)	1.00 [0.40-2.49]	0.86 [0.29-2.56]
Age Category at Time of A	· '	120 (0.70)	1.00 [0.70-2.73]	0.00 [0.23-2.30]
1	37 (25.17)	284 (18.82)	1.57 [0.85-2.90]	1.39 [0.69-2.81]
2	102 (69.39)	1,097 (72.7)	1.00 [referent]	1.39 [0.69-2.81] 1.00 [referent]
3	8 (5.44)	† · · · · · · · · · · · · · · · · · · ·		
	0 (3.44)	128 (8.48)	0.62 [0.22-1.77]	0.34 [0.09-1.24]
Total Number of Siblings	4E (20 61)	462 (20 60)	1.00 [roforont]	1 00 [roforon+]
1	45 (30.61)	463 (30.68)	1.00 [referent]	1.00 [referent]
2	59 (40.14)	595 (39.43)	1.05 [0.57-1.95]	1.38 [0.56-3.41]
3	22 (14.97)	292 (19.35)	0.71 [0.32-1.57]	0.83 [0.24-2.80]
>3	21 (14.29)	159 (10.54)	1.62 [0.69-3.80]	1.72 [0.41-7.26]
Sociodemographic				
Index of Relative Socioec	1		T -	T .
Lowest Quintile	118 (80.27)	1,255 (83.17)	1.08 [0.54-2.17]	0.56 [0.23-1.36]
> Lowest Quintile	22 (14.97)	215 (14.25)	1.00 [referent]	1.00 [referent]

Unavailable 7 (4.76) 39 (2.58)

*p<0.05, **p<0.01, ***p<0.001

^a Excluded from multivariable analysis due to small N.

^b Age categories classified as; ≥3 years 10 months to <5 years and one month, 2) ≥5 years and one month to <5 years and 10 months (reference category), 3) \geq 5 years and 10 months to \leq 6 years 10 months.

Table 4. Risk Factors for Developmental Vulnerability on the Language & Cognitive Skills (school-based) Domain.

pased) Domain.		-		
	DV	NDV	Bivariate	Multivariable
Characteristic	(N=195)	(N=1,461)		(N=1,352)
	N (%)	N (%)	OR [95% CI]	aOR [95% CI]
Maternal				
Age at Time of Child's Birt		_		
≤20 years	34 (17.44)	48 (3.29)	77.73 [13.95-433.08]***	50.23 [5.53-456.36]***
21-25 years	41 (21.03)	163 (11.16)	7.00 [1.97-24.87]***	5.29 [1.25-22.34] [*]
26-30 years	38 (19.49)	396 (27.10)	1.00 [referent]	1.00 [referent]
31-35 years	53 (27.18)	545 (37.30)	1.07 [0.39-2.96]	1.32 [0.40-4.32]
36-40 years	20 (10.26)	270 (18.48)	0.65 [0.19-2.30]	0.98 [0.23-4.28]
>40 years	9 (4.62)	39 (2.67)	5.98 [0.72-49.99]	6.45 [0.53-79.03]
Marital Status				
Married (inc. de facto)	145 (74.36)	1,335 (91.38)	1.00 [referent]	1.00 [referent]
All Other	50 (25.64)	120 (8.21)	18.44 [5.70-59.63]***	4.65 [1.13-19.18] [*]
Unavailable	0 (0.00)	6 (0.41)		
Occupational Status Scale	at Time of Child's B	irth		
0-20	70 (35.90)	239 (16.36)	10.48 [2.85-38.53]***	2.48 [0.55-11.3]
>20-40	48 (24.62)	339 (23.20)	2.30 [0.67-7.93]	1.26 [0.31-5.17]
>40-60	24 (12.31)	385 (26.35)	0.43 [0.11-1.60]	0.41 [0.09-1.79]
>60-80	7 (3.59)	192 (13.14)	0.19 [0.03-1.17]	0.20 [0.02-1.69]
>80-100	26 (13.33)	264 (18.07)	1.00 [referent]	1.00 [referent]
Unavailable	20 (10.26)	42 (2.87)		
Pregnancy & Birth				
Fertility Treatments				
No	180 (92.31)	1,208 (82.68)	1.00 [referent]	1.00 [referent]
Yes	15 (7.69)	253 (17.32)	0.16 [0.04-0.55]	0.40 [0.08-1.89]
Smoking Status During Pre	' '			1
No	145 (74.36)	1,273 (87.13)	1.00 [referent]	1.00 [referent]
Yes	50 (25.64)	188 (12.87)	6.35 [2.24-18.01]***	0.30 [0.08-1.18]
Pre-eclampsia	00 (2010 1)	1 = 55 (= = 55)	V	(
No	176 (90.26)	1,284 (87.89)	1.00 [referent]	1.00 [referent]
Yes	19 (9.74)	177 (12.11)	0.61 [0.18-2.10]	1.15 [0.27-4.79]
Gestational Diabetes	20 (0)		0.02 [0.20 2.20]	
No No	184 (94.36)	1,370 (93.77)	1.00 [referent]	1.00 [referent]
Yes	11 (5.64)	91 (6.23)	0.84 [0.16-4.44]	0.75 [0.13-4.46]
Threatened Abortion	11 (5.04)	31 (0.23)	0.04 [0.10 4.44]	0.75 [0.15 4.40]
No	189 (96.92)	1,383 (94.66)	1.00 [referent]	1.00 [referent]
Yes	6 (3.08)	78 (5.34)	0.36 [0.05-2.41]	0.17 [0.01-3.21]
Other Pregnancy Related (78 (3.34)	0.30 [0.03-2.41]	0.17 [0.01-3.21]
No	53 (27.18)	523 (35.80)	1.00 [referent]	1.00 [referent]
Yes	142 (72.82)	938 (64.20)	1.96 [0.84-4.54]	1.37 [0.48-3.91]
Threatened Preterm Labor	` '	338 (04.20)	1.50 [0.04-4.54]	1.57 [0.40-5.51]
No	ui	_	14.00 [[]	14001 1 11
	162 (02 00)	1 202 (90 12)		
	162 (83.08)	1,302 (89.12)	1.00 [referent]	1.00 [referent]
Yes	162 (83.08) 33 (16.92)	1,302 (89.12) 159 (10.88)	3.21 [0.80-12.92]	1.43 [0.39-5.32]
Yes APH	33 (16.92)	159 (10.88)	3.21 [0.80-12.92]	1.43 [0.39-5.32]
Yes APH No	33 (16.92) 183 (93.85)	159 (10.88) 1,415 (96.85)	3.21 [0.80-12.92] 1.00 [referent]	1.43 [0.39-5.32] 1.00 [referent]
Yes APH No Yes	33 (16.92)	159 (10.88)	3.21 [0.80-12.92]	1.43 [0.39-5.32]
Yes APH No Yes Placenta Praevia	33 (16.92) 183 (93.85) 12 (6.15)	159 (10.88) 1,415 (96.85) 46 (3.15)	3.21 [0.80-12.92] 1.00 [referent]	1.43 [0.39-5.32] 1.00 [referent]
Yes APH No Yes Placenta Praevia No	33 (16.92) 183 (93.85) 12 (6.15) 195 (100.00)	1,415 (96.85) 46 (3.15) 1,451 (99.32)	3.21 [0.80-12.92] 1.00 [referent]	1.43 [0.39-5.32] 1.00 [referent]
Yes APH No Yes Placenta Praevia No Yes	33 (16.92) 183 (93.85) 12 (6.15)	159 (10.88) 1,415 (96.85) 46 (3.15)	3.21 [0.80-12.92] 1.00 [referent]	1.43 [0.39-5.32] 1.00 [referent]
Yes APH No Yes Placenta Praevia No Yes Placental Abruption	33 (16.92) 183 (93.85) 12 (6.15) 195 (100.00) 0 (0.00)	159 (10.88) 1,415 (96.85) 46 (3.15) 1,451 (99.32) 10 (0.68)	3.21 [0.80-12.92] 1.00 [referent]	1.43 [0.39-5.32] 1.00 [referent]
Yes APH No Yes Placenta Praevia	33 (16.92) 183 (93.85) 12 (6.15) 195 (100.00)	1,415 (96.85) 46 (3.15) 1,451 (99.32)	3.21 [0.80-12.92] 1.00 [referent]	1.43 [0.39-5.32] 1.00 [referent]

No	173 (88.72)	1,345 (92.06)	1.00 [referent]	1.00 [referent]
Yes	22 (11.28)	116 (7.94)	2.04 [0.45-9.17]	0.63 [0.13-3.10]
Cephalopelvic Disproport	tion ^a			
No	195 (100.00)	1,457 (99.73)		
Yes	0 (0.00)	4 (0.27)		
Prolapsed Cord ^a	•	•		•
No	192 (98.46)	1,451 (99.32)		
Yes	3 (1.54)	10 (0.68)		
Precipitate Delivery ^a				•
No	190 (97.44)	1,440 (98.56)		
Yes	5 (2.56)	21 (1.44)		
PPH ≥500mls	•	•		•
No	123 (63.08)	1076 (73.65)	1.00 [referent]	1.00 [referent]
Yes	72 (36.92)	385 (26.35)	3.13 [1.22-8.05]*	1.72 [0.64-4.64]
TSR ≥2mins		<u> </u>		
No	163 (83.59)	1,261 (86.31)	1.00 [referent]	1.00 [referent]
Yes	32 (16.41)	200 (13.69)	0.95 [0.39-2.30]	0.60 [0.20-1.84]
Apgar 5-minutes <7 a		(- /-/		
No	193 (98.97)	1,430 (97.88)		
Yes	2 (1.03)	31 (2.12)		
Intubation	, , , , ,	. , ,		
No	159 (81.54)	1,230 (84.19)	1.00 [referent]	1.00 [referent]
Yes	36 (18.46)	231 (15.81)	1.13 [0.49-2.58]	1.46 [0.51-4.13]
Early Preterm Birth	100 (20:10)	(20.02)		
No	155 (79.49)	1,255 (85.90)	1.00 [referent]	1.00 [referent]
Yes	40 (20.51)	206 (14.10)	2.57 [0.75-8.80]	0.75 [0.21-2.68]
POBW <15 th Percentile				1 - 1 - 1 - 1
No	142 (72.82)	1,089 (74.54)	1.00 [referent]	1.00 [referent]
Yes	36 (18.46)	181 (12.39)	1.62 [0.72-3.66]	1.74 [0.71-4.26]
Unavailable	17 (8.72)	191 (13.07)		
Parity	, ,	,		
0	51 (26.15)	611 (41.82)	1.00 [referent]	1.00 [referent]
1	81 (41.54)	502 (34.36)	4.67 [1.71-12.70]**	6.24 [1.46-26.73]*
≥2	63 (32.31)	348 (23.82)	6.18 [2.09-18.27]**	6.25 [0.96-40.69]
Child	00 (02.02)	0.0 (20.02)	0.12 [2.00 20.1.]	oles (else leles)
Sex				
Female	85 (43.59)	765 (52.36)	1.00 [referent]	1.00 [referent]
Male	110 (56.41)	696 (47.64)	3.03 [1.60-5.71]***	3.57 [1.70-7.49]***
Ethnicity	(=== (=====			
Other	165 (84.62)	1,407 (96.30)	1.00 [referent]	1.00 [referent]
Indigenous Australian	30 (15.38)	54 (3.70)	34.27 [7.49-156.82]***	2.08 [0.30-14.36]
Child Speaks Language O	· '	, ,	0 1127 [71.15 250.02]	2.00 [0.00 2 1.00]
No	167 (85.64)	1,349 (92.33)	1.00 [referent]	1.00 [referent]
Yes	28 (14.36)	112 (7.67)	3.82 [0.89-16.47]	1.59 [0.37-6.87]
Age Category at Time of	· · · · · · · · · · · · · · · · · · ·	112 (7.07)	3.02 [0.03 10.47]	1.55 [0.57 0.07]
1	48 (24.62)	273 (18.69)	2.09 [0.74-5.89]	1.98 [0.71-5.53]
2	128 (65.64)	1,071 (73.31)	1.00 [referent]	1.00 [referent]
3	19 (9.74)	117 (8.01)	2.56 [0.56-11.82]	1.21 [0.25-5.84]
Total Number of Siblings	13 (3./7)	117 (0.01)	2.30 [0.30-11.02]	1 1.21 [0.25-5.04]
1	41 (21.03)	467 (31.96)	1.00 [referent]	1.00 [referent]
2	79 (40.51)	575 (39.36)	2.82 [1.01-7.88]*	0.40 [0.09-1.73]
3	35 (17.95)		2.82 [1.01-7.88]	
>3		279 (19.10)	2.40 [0.71-8.13] 17.34 [4.37-68.74]***	0.18 [0.03-1.11]
	40 (20.51)	140 (9.58)	17.34 [4.37-08.74]	1.83 [0.25-13.51]
Sociodemographic	onomia Disa-kurus			
Index of Relative Socioed	_		C 07 [4 00 3C 30]**	4 25 [0 20 4 02]
Lowest Quintile	141 (72.31)	1,232 (84.33)	6.87 [1.80-26.28]**	1.25 [0.39-4.03]

> Lowest Quintile	46 (23.59)	191 (13.07)	1.00 [referent]	1.00 [referent]
Unavailable	8 (4.10)	38 (2.60)		

^{*}p<0.05, **p<0.01, ***p<0.001

^a Excluded from multivariable analysis due to small N.

^b Age categories classified as; ≥3 years 10 months to <5 years and one month, 2) ≥5 years and one month to <5 years and at ,ths to 10 months (reference category), 3) \geq 5 years and 10 months to <6 years 10 months.

Table 5. Risk Factors for Developmental Vulnerability on the Communication Skills & General Knowledge Domain.

Knowledge Domain.				
	DV	NDV	Bivariate	Multivariable
Characteristic	(N=200)	(N=1,456)		(N=1,352)
	N (%)	N (%)	OR [95% CI]	aOR [95% CI]
Maternal				
Age at Time of Child's Birth		_		
≤20 years	30 (15.00)	52 (3.57)	41.57 [7.10-243.32]***	3.51 [0.36-34.23]
21-25 years	34 (17.00)	170 (11.68)	3.32 [0.87-12.70]	3.65 [0.83-16.03]
26-30 years	46 (23.00)	388 (26.65)	1.00 [referent]	1.00 [referent]
31-35 years	60 (30.00)	538 (36.95)	0.81 [0.28-2.38]	1.77 [0.51-6.05]
36-40 years	22 (11.00)	268 (18.41)	0.49 [0.13-1.84]	1.54 [0.34-7.09]
>40 years	8 (4.00)	40 (2.75)	2.98 [0.29-31.20]	6.24 [0.39-100.11]
Marital Status				
Married (inc. de facto)	160 (80.00)	1,320 (90.66)	1.00 [referent]	1.00 [referent]
All Other	40 (20.00)	130 (8.93)	14.40 [2.74-75.72]***	2.24 [0.50-9.97]
Unavailable	0 (0.00)	6 (0.41)		
Occupational Status Scale a	t Time of Child's Birth	า		
0-20	68 (34.00)	241 (16.55)	24.18 [5.14-113.78]***	5.54 [1.00-30.80]
>20-40	65 (32.50)	322 (22.12)	11.01 [2.55-47.62]**	6.60 [1.33-32.64]*
>40-60	21 (10.50)	388 (26.65)	0.68 [0.16-2.99]	0.63 [0.12-3.34]
>60-80	12 (6.00)	187 (12.84)	0.83 [0.14-4.79]	1.00 [0.13-7.32]
>80-100	19 (9.50)	271 (18.61)	1.00 [referent]	1.00 [referent]
Unavailable	15 (7.50)	47 (3.23)		
Pregnancy & Birth		, ,		
Fertility Treatments	•	_		
No	188 (94.00)	1,200 (82.42)	1.00 [referent]	1.00 [referent]
Yes	12 (6.00)	256 (17.58)	0.10 [0.02-0.39]	0.29 [0.06-1.48]
Smoking Status During Preg	· · · · · · · · · · · · · · · · · · ·		1 (
No	148 (74.00)	1,270 (87.23)	1.00 [referent]	1.00 [referent]
Yes	52 (26.00)	186 (12.77)	7.79 [2.61-23.28]***	1.49 [0.41-5.32]
Pre-eclampsia	02 (20.00)	1 200 (22.7.7)		
No	175 (87.50)	1,285 (88.26)	1.00 [referent]	1.00 [referent]
Yes	25 (12.50)	171 (11.74)	1.07 [0.29-3.90]	1.11 [0.26-4.88]
Gestational Diabetes	25 (12.50)	171 (11.74)	1.07 [0.23 3.30]	1.11 [0.20 4.00]
No No	187 (93.50)	1,367 (93.89)	1.00 [referent]	1.00 [referent]
Yes	13 (6.50)	89 (6.11)	1.16 [0.20-6.72]	1.23 [0.20-7.42]
Threatened Abortion	13 (0.50)	89 (0.11)	1.10 [0.20-0.72]	1.23 [0.20-7.42]
No	192 (96.00)	1,380 (94.78)	1.00 [referent]	1.00 [referent]
Yes	8 (4.00)	76 (5.22)	0.55 [0.09-3.48]	0.27 [0.02-4.28]
Other Pregnancy Related Co		76 (3.22)	0.55 [0.09-5.46]	0.27 [0.02-4.26]
No	51 (25.50)	525 (36.06)	1.00 [referent]	1.00 [referent]
Yes	149 (74.50)	931 (63.94)	2.53 [1.07-6.00]*	1.50 [0.49-4.57]
	, ,	951 (05.94)	2.55 [1.07-6.00]	1.30 [0.49-4.57]
Threatened Preterm Labour		1 206 (00 22)	1.00 [referent]	1 00 [roforont]
No Vos	178 (89.00)	1,286 (88.32)	1.00 [referent] 1.00 [0.27-3.61]	1.00 [referent]
Yes	22 (11.00)	170 (11.68)	1.00 [0.27-3.01]	0.54 [0.13-2.27]
APH No.	100 (04 00)	1 410 (06 94)	1.00 [roforon+]	1.00 [roforont]
No	188 (94.00)	1,410 (96.84)	1.00 [referent]	1.00 [referent]
Yes	12 (6.00)	46 (3.16)	9.09 [0.70-117.63]	1.17 [0.12-11.45]
Placenta Praevia ^a	200 (400 00)	1 446 (00 24)		
	0 (0.00)	10 (0.69)		
•	100 (00 ==)	451 (00		
	1 (0.50)	5 (0.34)		
No Yes Placental Abruption a No Yes	200 (100.00) 0 (0.00) 199 (99.50) 1 (0.50)	1,446 (99.31) 10 (0.69) 1,451 (99.66) 5 (0.34)		
Fetal Distress	1 ± (0.50)	1 3 (0.57)		

No	172 (86.00)	1,346 (92.45)	1.00 [referent]	1.00 [referent]
Yes	28 (14.00)	110 (7.55)	4.73 [1.00-22.38]	2.73 [0.64-11.65]
Cephalopelvic Disproportion	1	, ,	•	
No	200 (100.00)	1,452 (99.73)		
Yes	0 (0.00)	4 (0.27)		
Prolapsed Cord ^a	•			•
No	200 (100)	1,443 (99.11)		
Yes	0 (0.00)	13 (0.89)		
Precipitate Delivery ^a				
No	195 (97.50)	1,435 (98.56)		
Yes	5 (2.50)	21 (1.44)		
PPH ≥500mls				
No	122 (61.00)	1,077 (73.97)	1.00 [referent]	1.00 [referent]
Yes	78 (39.00)	379 (26.03)	3.72 [1.41-9.86]**	2.22 [0.79-6.23]
TSR ≥2mins			•	
No	163 (81.50)	1,261 (86.61)	1.00 [referent]	1.00 [referent]
Yes	37 (18.50)	195 (13.39)	2.80 [1.08-7.22]*	1.45 [0.47-4.45]
Apgar 5-minutes <7 ^a		•	-	-
No	198 (99.00)	1,425 (97.87)		
Yes	2 (1.00)	31 (2.13)		
Intubation				
No	162 (81.00)	1,227 (84.27)	1.00 [referent]	1.00 [referent]
Yes	38 (19.00)	229 (15.73)	1.91 [0.80-4.56]	1.27 [0.44-3.71]
Early Preterm Birth			•	•
No	157 (78.50)	1,253 (86.06)	1.00 [referent]	1.00 [referent]
Yes	43 (21.50)	203 (13.94)	3.73 [0.99-14.09]	1.95 [0.57-6.75]
POBW <15 th Percentile				
No	146 (73.00)	1,085 (74.52)	1.00 [referent]	1.00 [referent]
Yes	36 (18.00)	181 (12.43)	1.83 [0.78-4.33]	1.74 [0.71-4.29]
Unavailable	18 (9.00)	190 (13.05)		
Parity				
0	65 (32.50)	597 (41.00)	1.00 [referent]	1.00 [referent]
1	68 (34.00)	515 (35.37)	1.51 [0.59-3.86]	1.26 [0.30-5.35]
≥2	67 (33.50)	344 (23.63)	4.54 [1.47-14.09]**	1.48 [0.23-9.64]
Child				
Sex				
Female	87 (43.50)	763 (52.40)	1.00 [referent]	1.00 [referent]
Male	113 (56.50)	693 (47.60)	3.00 [1.56-5.79]**	3.25 [1.50-7.03]**
Ethnicity				
Other	179 (89.50)	1,393 (95.67)	1.00 [referent]	1.00 [referent]
Indigenous Australian	21 (10.50)	63 (4.33)	21.66 [2.34-200.50]**	1.06 [0.13-8.59]
Child Speaks Language Other	Than English at Hor	ne		
No	161 (80.50)	1,355 (93.06)	1.00 [referent]	1.00 [referent]
Yes	39 (19.50)	101 (6.94)	11.16 [3.30-37.77]***	15.16 [3.57-64.30]***
Age Category at Time of AEDO	C Completion b			
1	57 (28.5)	264 (18.13)	5.60 [1.73-18.09]**	5.11 [1.71-15.30]**
2	125 (62.5)	1074 (73.76)	1.00 [referent]	1.00 [referent]
3	18 (9)	118 (8.1)	1.91 [0.44-8.30]	1.63 [0.31-8.57]
Total Number of Siblings				
1	49 (24.50)	459 (31.52)	1.00 [referent]	1.00 [referent]
2	77 (38.50)	577 (39.63)	1.54 [0.58-4.13]	0.89 [0.20-3.94]
3	37 (18.50)	277 (19.02)	1.64 [0.49-5.44]	1.07 [0.17-6.68]
>3	37 (18.50)	143 (9.82)	15.85 [2.91-86.42]**	4.07 [0.48-34.74]
Sociodemographic				
Index of Relative Socioeconor	mic Disadvantage			
Lowest Quintile	153 (76.50)	1,220 (83.79)	4.24 [1.12-16.03] [*]	0.69 [0.20-2.44]

> Lowest Quintile	42 (21.00)	195 (13.39)	1.00 [referent]	1.00 [referent]
Unavailable	5 (2.50)	41 (2.82)		

^{*}p<0.05, **p<0.01, ***p<0.001

^a Excluded from multivariable analysis due to small N.

^b Age categories classified as; ≥3 years 10 months to <5 years and one month, 2) ≥5 years and one month to <5 years and aths to 10 months (reference category), 3) \geq 5 years and 10 months to <6 years 10 months.

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of cohort studies

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	3
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	3
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	7
		(b) For matched studies, give matching criteria and number of exposed and unexposed	n/a
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7-10
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7-10
Bias	9	Describe any efforts to address potential sources of bias	7-10
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7-10
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	10
		(b) Describe any methods used to examine subgroups and interactions	10
		(c) Explain how missing data were addressed	10
		(d) If applicable, explain how loss to follow-up was addressed	10
		(e) Describe any sensitivity analyses	10
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed	10-11
		eligible, included in the study, completing follow-up, and analysed	
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	10-11
		(b) Indicate number of participants with missing data for each variable of interest	
		(c) Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	Report numbers of outcome events or summary measures over time	
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence	10-11
		interval). Make clear which confounders were adjusted for and why they were included	
		(b) Report category boundaries when continuous variables were categorized	10-11
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	12
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	4
Generalisability	21	Discuss the generalisability (external validity) of the study results	15
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	17

^{*}Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

The associations between biological and sociodemographic risks for developmental vulnerability in twins at age five: A population data linkage study in Western Australia.

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2	2	Manuscript
	3	Title: The associations between biological and sociodemographic risks for developmental
5 6	4	vulnerability in twins at age five: A population data linkage study in Western Australia.
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8 9	6	Gursimran K. Dhamrait, ^{1,2} Daniel Christensen, ^{1,3} Gavin Pereira ^{1,4,5} and Catherine L. Taylor. ^{1,3}
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40 2		Main Body Word Count: 4,181 words
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45 2	27	Short Title: Developmental vulnerability in twins at age five
46 47 ²	28	
48 49	29	Abbreviations
50 3		AEDC: Australian Early Development Census
51 52 3	31	ARIA: Accessibility and Remoteness Index of Australia
53 54	32	AUSEI06: Australian Socioeconomic Index 2006
55 ₃		DV1: Developmentally Vulnerable on one or more Australian Early Development Census domains
57 3	34	DV2: Developmentally Vulnerable on two or more Australian Early Development Census domains
58 59 3	35	CI: Confidence Interval
60 3		IRSD: Index of Relative Socioeconomic Disadvantage

MNS: Midwives Notifications System

3 38 OR: Odds Ratio

POBW: Proportion of Optimal Birthweight

WA: Western Australia

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10 42

Keywords (max of 5):

Twins, Australian Early Development Census, Child Development, Record Linkage.



- 44 **Abstract** 45 Objective: To investigate the prevalence of, and associations between, prenatal and perinatal risk 46 factors and developmental vulnerability in twins at age five. Design: Retrospective cohort study using bivariate and multivariable logistic regression. 47 Setting: Western Australia (WA), 2002-2015. Participants: 828 twin pairs born in WA with an Australian Early Development Census (AEDC) record from 2009, 2012 or 2015. Main Outcome Measures: The AEDC is a national measure of child development across five domains. Children with scores <10th percentile were classified as developmentally vulnerable on, one or more domains (DV1), or two or more domains (DV2). Results: In this population, 26.0% twins were classified as DV1 and 14.1% as DV2. In the multivariable model, risk factors for DV1 were; maternal age <25 years (OR 7.06, 95% CI 2.29-21.76), child speaking a language other than English at home (OR 6.45, 95% CI 2.17-19.17), male child (OR 5.08, 95% CI: 2.89-8.92), age younger than the reference category for the study sample (≥5 vears one month to <5 years 10 months) at time of AEDC completion (OR 3.34, 95% CI: 1.55-7.22). and having a proportion of optimal birthweight (POBW) <15th percentile of the study sample (OR 2.06, 95% CI 1.07-3.98). Risk factors for DV2 were; male child (OR 7.87, 95% CI: 3.45-17.97). maternal age <25 years (OR 5.60, 95% CI: 1.30-24.10), age younger than the reference category (OR 5.36, 95% CI: 1.94-14.82), child speaking a language other than English at home (OR 4.65, 95% CI: 1.14-19.03), mother's marital status as not married at the time of twins' birth (OR 4.59, 95% CI: 1.13-18.55), maternal occupation status in the lowest quintile (OR 3.30, 95% CI: 1.11-9.81) and having a
- Conclusion: Both biological and sociodemographic risk factors are associated with developmental vulnerability in twins at five years of age.

POBW <15th (OR 3.11, 95% CI: 1.26-7.64).

Article Summary

Strengths and Limitations

- The study is based on a large population-level sample of 1,656 twins.
- This is the first twin study to assess developmental vulnerabilities in an otherwise healthy sample of Australian twins, at the time of their first year of full-time school.
- Bivariate and multivariable logistic regression analysis with the calculation of adjusted odds ratios was performed to explore the associations between a large range of prenatal and perinatal risk factors.
- Twin pairs for which data was complete were used for the analysis.
- The datasets used in this study did not report on twin zygosity nor on complications of pregnancy that are specific to multiple pregnancies (e.g., twin reversed arterial perfusion, twintwin transfusion syndrome).

Introduction

The increased use of assisted reproductive technologies and increasing maternal age at conception have attributed to a significant increase in the number of multifetal pregnancies around the world.¹ Multifetal pregnancies are classified as high risk pregnancies and are associated with higher rates of pregnancy complications and adverse neonatal and perinatal outcomes, compared to singleton pregnancies.²⁻⁶ The majority of the literature assessing higher order pregnancies has focused primarily on birth outcomes, including preterm birth, low birth weight, and developmental disabilities such as cerebral palsy. 8 Studies that have assessed longer-term developmental outcomes of twins have focused on developmental outcomes around the age of two years. 9 Such studies have reported that twins had poorer performance, in comparison to singletons, on a range of domains including; communication, gross and fine motor skills, problem solving, personal-social skills, and language development. 10,11 Furthermore, most studies examining child development outcomes at school starting age have focused on singleton children, from a single family and have compared children across families. 12 There is a paucity of research on the developmental vulnerability of multifetal pregnancies such as twins, around the time that they commence formal education. Child development outcomes can vary significantly based on numerous factors including the child's personal characteristics, such as personal dispositions and abilities, social constructs and the environments, both intrauterine and extrauterine, in which they develop. 13-16 Studies that have assessed cognitive and school performance outcomes at the age of five have reported that children who are born preterm, ¹⁷⁻²⁴ with a low birth weight, ²⁵⁻²⁸ are small for gestational age, ^{29,30} and male ³¹⁻³⁴ are more likely to have poorer developmental outcomes. In comparison to singletons, twins are more likely to be classified as preterm³⁵ or low birth weight, and have fetal growth restriction.³⁶ Studies have reported that twins are more likely to have poorer neurodevelopmental outcomes compared to singletons, even after controlling for gestational age and birthweight.³⁷ A study reported that twins scored lower than singletons in both the Verbal and Performance IQ domains of the Wechsler Preschool and Primary Scale of Intelligence, at the ages of four and five years.³⁸ Likewise, twin studies have also reported sex differences, with girls scoring higher than boys at ages four and five

years.³⁸ The cumulative nature of school-based learning means that developmental gaps at school entry, are difficult to close over time.³⁹ Children who begin school with poor school readiness often struggle to catch up with their peers and tend to fall further behind as they progress through the subsequent years of schooling.³⁹ As the educational achievement trajectories are largely established by 7 years of age (year 3) children with poor school readiness are more likely to have lower later-life educational achievement. 40 Given the higher rates of pregnancy, neonatal and perinatal adversities observed in twins in comparison to singletons, twins are particularly at risk for developmental delays in the early childhood period. Twin studies, assessing the contribution of genes and the environment, have supported the hypothesis that both factors impact child development. 41-44 Yet, a number of studies have reported no significant differences in child development outcomes based on zygosity. 38,45,46 Sociodemographic factors such as low socioeconomic status and low levels of parental education, have also been identified to adversely impact child development outcomes.⁴⁷⁻⁴⁹ A study conducted in younger twins (assessed at age 6, 12 and 18 months) reported that biological factors including low birth weight, were associated with poorer early cognitive and non-cognitive, independently of environmental factors, such as socioeconomic status.³ Alternatively, a study reported that the environmental factors shared by twins of the same family, were more significantly associated with early language skills and school readiness in twins at the age of five years, in comparison to genetic factors. 45 Overall, studies assessing both biological and sociodemographic factors and their impact on the longer-term child development of children born from multiple pregnancies remain sparse and the results of the existing studies are mixed.

The aim of this study was to examine the prevalence of, and the association between, biological and sociodemographic risk factors and developmental vulnerability in twins in their first year of full-time school.

Methods

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Data Sources and Study Population

Data Sources

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This study used anonymised individual-level data from the Midwives Notification System (MNS), which is statutory record of all births (still- or live-born) in WA with either a birthweight >400 grams and/or a final gestational length of ≥20 weeks. Variables from MNS were cross validated with corresponding records from WA Birth Registrations. Australian Early Development Census (AEDC) records were obtained for all available years (2009, 2012 and 2015) for all children with WA birth and perinatal records. WA Register for Developmental Anomalies (WARDA) records were used to identify children who had a diagnosed developmental disability between birth and age five years. Statistical linkage of all records, by matching identifiers (e.g. name, address, date of birth etc.) common to sets of records, ⁵⁰ was provided by the WA Data Linkage Branch from the Department of Health WA.

Patient and Public Involvement

No patients were involved in the development of the research question or the outcome measures, or in the development of the plans for the design or implementation of the study.

Study Population

The study population included all children born in WA with an AEDC record in either 2009, 2012 or 2015 (N=73,903). Children were excluded from the study if; 1) they were not from a twin birth (N=71,748), 2) they were identified by their teacher as having 'special-needs' based on a diagnosed physical and/or intellectual disability (N=123), 3) they were reported as having any birth defect in the WARDA datasets (N=119), 4) they had an AEDC score that was either incomplete or missing (N=22), or 5) their twin sibling was excluded based on the aforementioned exclusion criteria (N=235; Figure 1). The final study sample consisted of N=1,656 children; N=828 twin pairs. There were 252 opposite sex twin pairs and 576 same sex twin pairs (277 male and 299 female twin pairs).

Outcome Measure

The AEDC is a national census of early childhood development spanning five developmental domains; 1) Physical Health and Wellbeing, 2) Social Competence, 3) Emotional Maturity, 4)

Language and Cognitive skills (school-based), and 5) Communication Skills and General Knowledge.

The AEDC is conducted every three years, with the first national data collection conducted in 2009.

Children with scores <10th percentile in a given domain are classified as 'developmentally vulnerable.' AEDC cut-off scores are based on the first national AEDC data collection in 2009 and apply to all AEDC data collections. Domain scores for children with special needs are not included in the AEDC results. Two outcomes measures were used; developmentally vulnerable on one or more AEDC domains (DV1) and developmentally vulnerable on two or more AEDC domains (DV2).

Risk Variables

Maternal Variables

Maternal age and marital status at child's birth were obtained from the MNS and Birth Registrations. Maternal occupation at birth was obtained from Birth Registrations data and converted to a four-digit standard code using the Australian and New Zealand Standard Classification of Occupations. These codes were then assigned a value ranging from 0-100 using the Australian Socioeconomic Index 2006 (AUSEI06).⁵¹ Low AUSEI06 values are representative of low-status occupations and high values represent high-status occupations. This variable was collapsed into two categories; most disadvantaged quintile (i.e. AUSEI06 [0-20]) and greater than the most disadvantaged quintile (i.e. AUSEI06 >20). An AUSEI06 value of zero was assigned to records if occupation was reported as 'unemployed', 'stay at home parent' or 'pensioner.' For records where maternal occupation was not stated, an AUSEI06 value was not assigned and these cases were reported as missing.

Pregnancy and Birth Variables

We included several binary pregnancy and birth variables to indicate either the presence or absence; of fertility treatments, smoking during pregnancy, pre-eclampsia, gestational diabetes, threatened abortion, threatened preterm labour, antepartum haemorrhage (APH), placenta praevia, placental abruption, fetal distress, cephalopelvic disproportion, prolapsed cord, precipitate delivery, post-partum haemorrhage (PPH), intubation status, early preterm birth (<34 weeks of gestational age), and time to Spontaneous Respiration (TSR); with a TSR of ≥2 minutes forming the 'at risk' group and five-minute Apgar score; with a five-minute Apgar score of <7 forming the 'at risk' group.

The proportion of optimal birthweight (POBW) is a measure of fetal growth and is defined as birth weight divided by expected birth weight, in the absence of pathologic risk factors. This measure also

accounts for non-pathologic determinants of growth, including gestational age, birth order, sex of the child and maternal height⁵² and has been validated against ultrasound measurements.⁵³ We derived a binary proxy for fetal growth restriction as POBW <15th percentile, which corresponded to an observed birth weight less than 75.75% of that expected.⁹

We derived a general category for other pregnancy related complications (not elsewhere stated; such as urinary tract infection, pre-labour rupture of membranes) for all records. As records may have multiple pregnancy related complications, all records that had a complication that was not elsewhere stated in this study or had multiple complications of which at least one complication was not elsewhere stated in this study, formed the 'at risk' group for this variable.

Child Variables

Sex and ethnicity of child was obtained from the MNS and Birth Registrations. Age at the time of AEDC completion and language other than English spoken at home by the child were obtained from the AEDC. Age of children at the time of AEDC completion ranged between; ≥ 3 years 10 months to <6 years 10 months, with a mean of age category of, ≥ 5 years one month to 5 years 10 months. To balance frequencies, the age of children at the time of AEDC completion was categorised into three groups; 1) ≥ 3 years 10 months to <5 years and one month, 2) ≥ 5 years one month to <5 years 10 months (reference category) and 3) ≥ 5 years 10 months to <6 years 10 months.

The total number of siblings were derived as the number of live births to each mother prior to the year that the cohort child had the AEDC conducted. Siblings who died within the neonatal period (i.e. mode of separation post-birth from the hospital was death) were excluded in the calculations for total number of siblings.

Sociodemographic Variables

The Index of Relative Socioeconomic Disadvantage (IRSD)¹⁹ was calculated using the residential address at the time of birth. ISRD is derived from Australian Census data and reflects area-level disadvantage through variables such as low household income, low educational attainment and high levels of unemployment. This variable was collapsed into two groups; most disadvantaged quintile (i.e. ISRD quintile 1) and greater than the most disadvantaged quintile (i.e. ISRD quintiles 2-5).

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Statistical Modelling

For each risk variable, the 'least risk' category (e.g. not early preterm birth) was used as the reference category (Table 1). To estimate the risk of a child being classified as DV1 and DV2, a generalised linear mixed model with a logit link function was used with a random intercept for each twin pair. A total of 30 maternal, pregnancy, birth, child and sociodemographic risk variables were considered for the multivariable models. For DV1, DV2, and each of the five AEDC domains, 24 risk variables were included in the multivariable models; six risks variables were excluded from multivariable analysis due to the prevalence being too small (total N<50 for a given category of a given variable). The variables excluded were; 1) placenta praevia, 2) placental abruption, 3) cephalopelvic disproportion, 4) prolapsed cord, 5) precipitate delivery and 6) a five-minute Apgar score of <7. All variables were added simultaneously to the models. Odds ratios (OR) and the associated 95% confidence intervals (CIs) were estimated for both unadjusted and adjusted models. All analyses were undertaken using PROC GLIMMIX in SAS version 9.4 for Windows.⁵⁴

Results

Prevalence of developmental vulnerability in twins

A total of 431 (26.0%) twins were classified as DV1 (Table 1). A total of 151 (18.2%) twin pairs had one twin identified as DV1 and 140 (16.9%) twin pairs had both twins were identified as DV1. Of the 24 maternal, pregnancy and birth, child and sociodemographic risk variables considered in the multivariable models, five variables had a statistically significant association with an increased risk of a twin being classified as DV1. In order of decreasing magnitude of associated risk, the ORs were; maternal age of <25 younger at time of twins' birth (OR 7.06, 95% CI 2.29 to 21.76), child speaks language other than English at home (OR 6.45, 95% CI 2.17 to 19.17), male twins (OR 5.08, 95% CI 2.89 to 8.92), child's age younger than the reference category for the study sample (≥5 years one month to 5 years 7 months) at time of AEDC completion (OR 3.34, 95% CI: 1.55 to 7.22), and POBW <15th percentile (OR 2.06, 95% CI 1.07 to 3.98).

A total of 223 (14.1%) twins were classified as DV2 (Table 2). In 95 (11.5%) twin pairs, one twin was

identified as DV2 and in 64 twin pairs (7.9%), both twins were identified as DV2. Of the 24 maternal,

pregnancy and birth, child and sociodemographic risk variables considered in the adjusted models, seven variables had a statistically significant association with an increased risk of a twin being classified as DV2. Risk factors for DV2 were, in order of decreasing magnitude; male twins (OR 7.87, 95% CI: 3.45 to 17.97), maternal age of <25 younger at time of twins' birth (OR 5.60, 95% CI: 1.30 to 24.10), child's age younger than the reference category at time of AEDC completion (OR 5.36, 95% CI: 1.94 to 14.82), child speaking a language other than English at home (OR 4.65, 95% CI: 1.14 to 19.03), mother's marital status as not married at the time of twins' birth (OR 4.59, 95% CI: 1.13 to 18.55), maternal occupation status in the lowest quintile (OR 3.30, 95% CI: 1.11 to 9.81) and POBW <15th percentile (OR 3.11, 95% CI: 1.26 to 7.64).

Associations with domain-specific developmental vulnerability

A total of, 188 (11.4%) children were classified as developmentally vulnerable for the domains of: Physical Health and Wellbeing; 151 (9.1%) for Social Competence; 147 (8.9%) for Emotional Maturity; 195 (11.8%) for Language and Cognitive Skills (school-based); and 200 (12.0%) for Communication Skills and General Knowledge (Supplementary Tables 1-5, respectively). These results were broadly consistent with the findings for the aggregate measures of developmental vulnerability (DV1 and DV2). All variables that were statistically significant in the aggregated measures of developmental vulnerability were statistically significant for the domains.

Discussion

This study examined the associations between biological and sociodemographic risk factors and developmental vulnerability in twins in their first year of full-time school. To our knowledge, our study is the first of this scale (population-level sample of twins; N>1,600) to report on the prevalence of developmental vulnerabilities, in an otherwise healthy sample twins, at the time of their first year of full-time school. As studies have reported that twins are more likely to have poorer performance, in comparison to singletons, at the age of two^{10,11} it was pertinent to assess if the prevalence rates of developmental vulnerabilities is higher in twins at age five. We reported that in the WA population, 26.0% of twins were classified as DV1 and 14.1% as DV2 across the 2009, 2012 and 2015 AEDC cycles. In the general WA population, which includes twins and higher order multiples, 23.0% of

children were classified as DV1 and 11.3% of children were classified as DV2, across these AEDC cycles.⁵⁵ A large cohort study of 99,530 singleton children from New South Wales reported that 20.8% were classified as DV1 across the 2009 and 2012 AEDC cycles. 56 Thus, we found that twins are at an elevated risk of developmental vulnerability relative to a general population of children in the state of Western Australia and in a singleton population in New South Wales. This is consistent with findings from a study of 142 twin pairs from the Louisville Twin Study, that reported twins scored lower than singletons in both the Verbal and Performance IQ domains of the Wechsler Preschool and Primary Scale of Intelligence at both four and five years of age.³⁸ As our results were obtained from a sample of twins without any diagnosed developmental disabilities, the higher prevalence rates of twins being classified as DV1 and DV2 observed in our study, when compared to the general Australian population, suggests that healthy twins are more likely to be classified as developmental vulnerable on AEDC domains at school starting age when compared to their singleton counterparts. The biological factors associated with developmental vulnerability in twins were; male sex, fetal growth restriction, and younger chronological age at the time of AEDC completion. These results are in line with singleton studies^{31,57} which have reported that male children are more likely to be classified as developmentally vulnerable in their first year of full-time school, in comparison to female children. A study conducted in South Australia of 13,827 children, of which 3.4% where twins, also

classified as developmentally vulnerable in their first year of full-time school, in comparison to female children. A study conducted in South Australia of 13,827 children, of which 3.4% where twins, also reported that male twins were more likely to be classified as DV2, when compared to female twins, however this finding was not statistically significant.⁵⁸ The Louisville Twin Study also reported sex differences, with females scoring higher on Full Scale, Verbal, and Performance IQ, than males at ages four and five years, however, scores tended to converge at six years of age.³⁸
We also reported that twins younger than the reference category for this sample were more likely to be classified as developmentally vulnerable in their first year of full-time school. A study of 840
Canadian five-year old twins, aiming to assess the genetic and environmental factors influencing school readiness, reported that in the preliminary models age was positively correlated with the spatial recognition, numbers, and the letters components of the Lollipop test.⁵⁹ Furthermore, a recent

discussion paper identified the need for further research to assess the effects of delaying school entry for twins⁶⁰ thus, highlighting that further research is required to better understand if delaying school entry is beneficial for both short-term and long-term academic outcomes in twins. The sociodemographic risk factors associated with developmental vulnerability in twins included; maternal age and occupational status, and a not married maternal marital status, at the time of twins' birth, and the child speaking a language other than English at home. These results are supported by the South Australian study, that examined a range of variables also included in our study. 58 This study reported that maternal age, marital status and maternal occupation were associated with an increased risk of children being classified as DV2 on the AEDC.58 The South Australian study also reported that parity and smoking during pregnancy were also associated with an increased risk of children being classified as DV2.58 In our study we observed an increased but insignificant association between these risk variables and twins being classified as either DV1 or DV2. An interesting finding from our study was that speaking a language other than English at home was associated with an increased risk for twins being classified as DV1 and DV2. Previous studies have reported that approximately a fifth of Australian children are bilingual, 61 and the prevalence of twins speaking a language other than English at home in our study were in line with these results. Results from a study of an Australia wide study of 261,147 children, singletons and multiples, from the 2009 AEDC cycle reported that bilingual children proficient in English have been reported to have equal or slightly lower odds of being classed as DV1 when compared to their English-speaking background peers. 61 However, unlike our study, this study 61 did not report differences in developmental vulnerability based on plurality. Additionally, a Canadian study examining the school readiness profiles of 95,537 children in British Columbia⁶² reported that bilingualism was associated with positive social, emotional and cognitive development, as measured by the Early Development Index.³⁴ Differences in results may be attributed to the fact bilingualism may be a risk factor for twins however, it may not be a significant risk factor in a general population sample. The language groups most commonly spoken in WA after English (Mandarin, Italian and Vietnamese)⁶³ are different to

those most prevalent in British Colombia (Punjabi, Chinese and German).⁶⁴ Thus, the difference in findings between the Canadian study and our results may be attributable to this fact. Our findings have some accord with a cohort study examining the associations between biological and sociodemographic risk factors on late language emergence in 473 twins pairs at the age of two years.⁹ Taylor et al. reported that the risk factors for late language emergence in twins, without developmental disabilities, include fetal growth restriction. Interestingly, our study also identified fetal growth restriction as a risk factor for developmental vulnerability at age five, suggesting that the biological implications of a suboptimal intrauterine environment may be persist beyond infancy and into early childhood in twins who did not have diagnosed developmental disabilities. In contrast to our study, the Taylor et al. twin sample excluded twins with exposure to languages other than English. Their study found that sociodemographic risk factors (low maternal education, socioeconomic area disadvantage) were not associated with late language emergence at age two years. Our results suggest that sociodemographic factors including, maternal; age, marital status and occupational status, at time of twins' birth, and the child speaking a language other than English at home are also associated with an increased risk of developmental vulnerability at age five. The differences in findings between this study and our study suggest that sociodemographic characteristics may play a more significant role as risk variables at age five years compared to at the age of two years. This hypothesis is supported by a subsequent study of twins aged four years and six years, which reported that higher maternal education and older maternal age showed positive effects on language and non-verbal phenotypes.⁶ Furthermore, a study of a twin sample from the Quebec Newborn Twin Study, reported that environmental factors, such as socioeconomic status, rather than genetic factors were attributable to the predictive association observed between early language skills and school readiness, as measured by the Lollipop Test, in twins 63-months of age. 45 In our study, zygosity of twins could not be established as WA administrative data does not contain information on zygosity. Furthermore, we did not aim to assess the impact of within twin-pair discordance in regards to developmental vulnerabilities at age five. Thus, further research is required to better elucidate the impact and

interplay of biological and sociodemographic risk variables at different stages of development in

twins. Studies assessing twin-singleton differences often control for or select for factors such as prematurity, low birth weight, or parental socioeconomic status. 57,65,66 Our study however, draws attention to adverse effects of other risk factors, including POBW and maternal marital status, on child development outcomes at age five. An Australian cohort study of 1,922 children from the Northern Territory using linked administrative data, reported an increased, but non-significant, risk of twins being classified as DV1 on the AEDC, after controlling for a range of biological and sociodemographic variables used in our study including; sex, 5-minute Apgar score <7, area remoteness, ethnicity, child speaks a language other than English at home and maternal age at time of child's birth.⁵⁷ Although this study gave consideration to plurality as a risk factor for developmental vulnerability, it did not aim to assess the association between a comprehensive set of biological and sociodemographic risk factors. A Canadian study of 5-year old twins reported that shared environmental factors substantially accounted for cognitive school readiness (as measured by the Lollipop Test) as compared to genetic effects.⁵⁹ Likewise other studies have also reported that a range of family factors, which would be assumed to be shared by both twins, such as family income, maternal occupation, and employment status are associated with cognitive school readiness. 67,68 Further studies in this area are required, as the extent and nature of the risk factors associated with developmental vulnerability at age five in twins, remain not well-established. Preventative intervention studies have reported that programs designed to improve school readiness and high quality early childhood education and care, are effective for at-risk populations and can have significant long-term results. ^{69,70} The higher prevalence rates of DV1 and DV2 in twins observed in this study are indicative of the fact that twins form an at-risk group in terms of developmental vulnerability at the time at which children commence full-time school. Therefore, it is pertinent for those working in the early childhood education sector and for parents to be aware of the developmental vulnerabilities present in twins at the age at which children begin full-time school. In Australia, there has been call to provide increased quantity and quality of support service and

resources are required for twins and their families due to increased vulnerability⁶⁰ and the results of our study highlight this need.

Conclusions

Both biological and sociodemographic risk factors are associated with developmental vulnerability at the age of five in twins. The findings of our study suggest that twins are more likely to be classified as developmentally vulnerable at school starting age when compared to their singleton counterparts. In particular, the results draw attention to the hypothesis that prenatal and more significantly perinatal risk factors and sociodemographic environments in which twins are raised can impact developmental dhood. vulnerability in early childhood.

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Ethics Approval:

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Ethics approval for this study was granted by the Western Australian Department of Health Human Research Ethics Committee (2016/51) and the University of Western Australia Human Research Ethics Committee (RA/4/20/4776).

Declaration of interests:

The authors declare that they have no competing interests, no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

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Author Contributions:

GKD: led study conceptualisation and design, conducted the literature review, performed data manipulation, analysis and interpretation of findings, drafted the initial manuscript and reviewed and revised the manuscript critically for important intellectual content.

DC, GP and CLT: contributed to the study inception, the development of the design, interpretation of the results, manuscript revisions, the interpretation of the results and revised the manuscript critically for important intellectual content.

GKD, DC, GP and CLT: approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

Data Sharing:

The linked administrative data are owned by the government departments who approved the linkage and use of the data for this study. Use of the study data is restricted to named researchers. The current Human Research Ethics Committee approvals were obtained for public sharing and presentation of data on group level only, meaning the data used in this study cannot be shared by the authors. Collaborative research may be conducted according to the ethical requirements and relevant privacy legislations. Potential collaborators should contact author GP with their expression of interest. The steps involved in seeking permission for linkage and use of the data used in this study are the same for all researchers.

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Figures & Tables: (Total 1 Figure & 2 Tables)

Figure 1. Eligible Cohort and Numbers Included for Analyses.

AEDC = Australian Early Development Census. WARDA= Western Australian Register of Developmental Anomalies.

Table 1. Risk factors for children who are developmentally vulnerable on one or more AEDC domains (DV1).

DV1).						
	DV1	NDV1	Bivariate		Multivariable	
Characteristic	(N=431)	(N=1,225)		i	(N=1,352)	
	N (%)	N (%)	OR [95% CI]	p-value	aOR [95% CI]	p-value
Maternal						
Age at Time of Child's B	irth (years)					
<25	105 (24.36)	117 (9.55)	9.66 [3.68-25.32]	<0.0001	7.06 [2.29-21.76]	0.0007
25-29	90 (20.88)	294 (24.00)	1.00 [referent]		1.00 [referent]	
30-34	130 (30.16)	476 (38.86)	0.81 [0.38-1.72]	0.5763	0.89 [0.38-2.07]	0.7796
≥35	106 (24.59)	338 (27.59)	1.06 [0.48-2.36]	0.8856	1.19 [0.47-2.99]	0.7149
Marital Status						
Married (inc. de facto)	357 (82.83)	1,123 (91.67)	1.00 [referent]		1.00 [referent]	
All Other	72 (16.71)	98 (8.00)	5.99 [2.43-14.75]	0.0001	2.26 [0.76-6.71]	0.1401
Unavailable	2 (0.46)	4 (0.33)				
Occupational Status Sca	le at Time of Ch	ild's Birth				
0-20	122 (28.31)	187 (15.27)	5.58 [2.71-11.46]	<0.0001	1.83 [0.79-4.26]	0.1586
>20-100	279 (64.73)	1,006 (82.12)	1.00 [referent]		1.00 [referent]	
Unavailable	30 (6.96)	32 (2.61)				
Pregnancy & Birth						
Fertility Treatments		<u> </u>				
No	377 (87.47)	1,011 (82.53)	1.00 [referent]		1.00 [referent]	
Yes	54 (12.53)	214 (17.47)	0.43 [0.19-0.97]	0.0417	0.84 [0.32-2.23]	0.7291
Smoking Status During I	Pregnancy					
No	339 (78.65)	1,079 (88.08)	1.00 [referent]		1.00 [referent]	
Yes	92 (21.35)	146 (11.92)	4.31 [1.95-9.53]	0.0003	0.87 [0.34-2.27]	0.7785
Pre-eclampsia						
No	375 (87.01)	1,085 (88.57)	1.00 [referent]		1.00 [referent]	
Yes	56 (12.99)	140 (11.43)	1.40 [0.59-3.34]	0.4443	1.82 [0.68-4.88]	0.2373
Gestational Diabetes						
No	402 (93.27)	1,152 (94.04)	1.00 [referent]		1.00 [referent]	
Yes	29 (6.73)	73 (5.96)	1.30 [0.40-4.22]	0.6571	1.15 [0.33-4.09]	0.8263
Threatened Abortion			(V)			
No	416 (96.52)	1,156 (94.37)	1.00 [referent]		1.00 [referent]	
Yes	15 (3.48)	69 (5.63)	0.36 [0.09-1.45]	0.1514	0.23 [0.04-1.35]	0.1031
Other Pregnancy Relate	d Complications	•				
No	125 (29.00)	451 (36.82)	1.00 [referent]		1.00 [referent]	
Yes	306 (71.00)	774 (63.18)	2.08 [1.12-3.85]	0.0198	1.79 [0.85-3.79]	0.1285
Threatened Preterm Lal	oour					•
No	376 (87.24)	1,088 (88.82)	1.00 [referent]		1.00 [referent]	
Yes	55 (12.76)	137 (11.18)	1.34 [0.55-3.24]	0.5189	0.68 [0.25-1.83]	0.4461
APH			•			•
No	411 (95.36)	1,187 (96.90)	1.00 [referent]		1.00 [referent]	
Yes	20 (4.64)	38 (3.10)	2.38 [0.53-10.73]	0.2603	0.67 [0.12-3.85]	0.6502
Placenta Praevia ^a		•	•	•	· -	
No	429 (99.54)	1,217 (99.35)				
Yes	2 (0.46)	8 (0.65)				
Placental Abruption ^a	, , ,					
No	427 (99.07)	1,223 (99.84)				
Yes	4 (0.93)	2 (0.16)				
Fetal Distress						
No	382 (88.63)	1,136 (92.73)	1.00 [referent]		1.00 [referent]	
Yes	49 (11.37)	89 (7.27)	2.92 [1.13-7.58]	0.0277	1.76 [0.60-5.13]	0.3013
	43 (III.3/)				1	
		03 (7.127)				
Cephalopelvic Dispropo	rtion ^a					
		1,221 (99.67) 4 (0.33)				

No	428 (99.30)	1,215 (99.18)				
Yes	3 (0.70)	10 (0.82)				
Precipitate Delivery a						
No	424 (98.38)	1,206 (98.45)				
Yes	7 (1.62)	19 (1.55)				
PPH ≥500mls	,					•
No	281 (65.20)	918 (74.94)	1.00 [referent]		1.00 [referent]	
Yes	150 (34.80)	307 (25.06)	2.59 [1.39-4.82]	0.0029	1.52 [0.73-3.16]	0.2603
TSR ≥2mins	, ,					
No	364 (84.45)	1,060 (86.53)	1.00 [referent]		1.00 [referent]	
Yes	67 (15.55)	165 (13.47)	1.06 [0.56-1.99]	0.8628	0.52 [0.22-1.21]	0.1277
Apgar 5-minutes <7 a	,					
No	425 (98.61)	1,198 (97.80)				
Yes	6 (1.39)	27 (2.20)				
Intubation	, , ,	, ,			1	
No	353 (81.90)	1,036 (84.57)	1.00 [referent]		1.00 [referent]	
Yes	78 (18.10)	189 (15.43)	1.36 [0.75-2.45]	0.3129	1.54 [0.71-3.37]	0.2770
Early Preterm Birth		, ,		1		1
No	352 (81.67)	1,058 (86.37)	1.00 [referent]		1.00 [referent]	
Yes	79 (18.33)	167 (13.63)	2.08 [0.94-4.56]	0.0691	1.29 [0.53-3.15]	0.5788
POBW <15 th Percentile	, ,					1
No	305 (70.77)	926 (75.59)	1.00 [referent]		1.00 [referent]	
Yes	81 (18.79)	136 (11.10)	2.09 [1.14-3.84]	0.0174	2.06 [1.07-3.98]	0.0309
Unavailable	45 (10.44)	163 (13.31)				
Parity	, ,				1	
0	150 (34.80)	512 (41.80)	1.00 [referent]		1.00 [referent]	
1	154 (35.73)	429 (35.02)	1.62 [0.83-3.16]	0.1579	1.96 [0.77-5.00]	0.1594
≥2	127 (29.47)	284 (23.18)	2.50 [1.20-5.22]	0.0145	2.03 [0.55-7.48]	0.2881
Child						
Sex						
Female	176 (40.84)	674 (55.02)	1.00 [referent]		1.00 [referent]	
Male	255 (59.16)	551 (44.98)	4.44 [2.68-7.36]	<0.0001	5.08 [2.89-8.92]	<0.0001
Ethnicity						•
Other	385 (89.33)	1,187 (96.90)	1.00 [referent]		1.00 [referent]	
Indigenous Australian	46 (10.67)	38 (3.10)	16.98 [4.85-59.46]	<0.0001	2.46 [0.46-13.03]	0.2909
Child Speaks Language (Other Than Engl	ish at Home				•
No	367 (85.15)	1,149 (93.80)	1.00 [referent]		1.00 [referent]	
Yes	64 (14.85)	76 (6.20)	6.28 [2.48-15.90]	0.0001	6.45 [2.17-19.17]	0.0008
Age Category at Time of	AEDC Complet	on ^b				
1	109 (25.29)	212 (17.31)	2.93 [1.45-5.90]	0.0028	3.34 [1.55-7.22]	0.0022
2	288 (66.82)	911 (74.37)	1.00 [referent]		1.00 [referent]	
3	34 (7.89)	102 (8.33)	1.18 [0.43-3.27]	0.7460	0.77 [0.23-2.54]	0.6660
Total Number of Sibling	S					
1	119 (27.61)	389 (31.76)	1.00 [referent]		1.00 [referent]	
2	160 (37.12)	494 (40.33)	1.15 [0.58-2.30]	0.6845	0.70 [0.27-1.83]	0.4610
3	74 (17.17)	240 (19.59)	1.04 [0.45-2.41]	0.9264	0.44 [0.13-1.55]	0.1996
>3	78 (18.10)	102 (8.33)	7.28 [2.73-19.45]	<0.0001	2.71 [0.60-12.22]	0.1939
Sociodemographic						
Index of Relative Socioe	conomic Disadv	antage				
Lowest Quintile	327 (75.87)	1,046 (85.39)	3.55 [1.62-7.78]	0.0016	1.63 [0.66-4.02]	0.2871
> Lowest Quintile	87 (20.19)	150 (12.24)	1.00 [referent]		1.00 [referent]	
Unavailable	17 (3.94)	29 (2.37)				
8 Evaludad from multivari	11 1 1	11.3.7				

^a Excluded from multivariable analysis due to small N.

^b Age categories classified as; ≥3 years 10 months to <5 years and one month, 2) ≥5 years and one month to <5 years and 10 months (reference category), 3) ≥5 years and 10 months to <6 years 10 months.

Table 2. Risk factors for children who are developmentally vulnerable on two or more AEDC domains (DV2).

domains (DV2).	1	Т	T		T	
	DV2	NDV2	Bivariate		Multivariable	
Characteristic	(N=223)	(N=1,433)		1 .	(N=1,352)	l .
	N (%)	N (%)	OR [95% CI]	p-value	aOR [95% CI]	p-value
Maternal						
Age at Time of Child's Bi			I	T	T = • · ·	l
<25	63 (28.25)	159 (11.10)	7.81 [2.60-23.45]	0.0003	5.60 [1.30-24.10]	0.0208
25-29	48 (21.52)	336 (23.45)	1.00 [referent]		1.00 [referent]	
30-34	64 (28.70)	542 (37.82)	0.65 [0.26-1.63]	0.3563	0.92 [0.29-2.91]	0.8854
≥35	48 (21.52)	396 (27.63)	0.67 [0.25-1.81]	0.4335	0.77 [0.22-2.76]	0.6892
Marital Status	T		1		T	
Married (inc. de facto)	172 (77.13)	1,308 (91.28)	1.00 [referent]	<u> </u>		
All Other	49 (21.97)	121 (8.44)	9.91 [3.54-27.77]	<0.0001	4.59 [1.13-18.55]	0.0327
Unavailable	2 (0.90)	4 (0.28)				
Occupational Status Sca			T	T	T	
0-20	78 (34.98)	231 (16.12)	8.82 [3.72-20.89]	<0.0001	3.30 [1.11-9.81]	0.0322
>20-100	130 (58.30)	1,155 (80.60)	1.00 [referent]	1	1.00 [referent]	
Unavailable	15 (6.73)	47 (3.28)				
Pregnancy & Birth						
Fertility Treatments			T		T	
No	200 (89.69)	1,188 (82.90)	1.00 [referent]		1.00 [referent]	ı
Yes	23 (10.31)	245 (17.10)	0.35 [0.13-0.97]	0.0424	0.67 [0.17-2.69]	0.5673
Smoking Status During F			T			
No	166 (74.44)	1,252 (87.37)	1.00 [referent]		1.00 [referent]	I
Yes	57 (25.56)	181 (12.63)	5.83 [2.32-14.65]	0.0002	1.27 [0.38-4.30]	0.7000
Pre-eclampsia	1				T	
No	195 (87.44)	1,265 (88.28)	1.00 [referent]	T	1.00 [referent]	T
Yes	28 (12.56)	168 (11.72)	1.25 [0.41-3.86]	0.6930	2.45 [0.65-9.17]	0.1844
Gestational Diabetes	1				T	
No	208 (93.27)	1,346 (93.93)	1.00 [referent]		1.00 [referent]	T
Yes	15 (6.73)	87 (6.07)	1.44 [0.32-6.42]	0.6353	2.29 [0.46-11.44]	0.3124
Threatened Abortion	1	T				
No	214 (95.96)	1,358 (94.77)	1.00 [referent]		1.00 [referent]	I
Yes	9 (4.04)	75 (5.23)	0.54 [0.10-2.94]	0.4784	0.24 [0.02-3.08]	0.2735
Other Pregnancy Relate	d Complications				T	
No		519 (36.22)	1.00 [referent]		1.00 [referent]	T
Yes	166 (74.44)	914 (63.78)	2.64 [1.22-5.69]	0.0136	1.64 [0.58-4.61]	0.3510
Threatened Preterm Lab		T			T	
No	191 (85.65)	1,273 (88.83)	1.00 [referent]		1.00 [referent]	
Yes	32 (14.35)	160 (11.17)	2.04 [0.66-6.29]	0.2163	0.72 [0.20-2.61]	0.6131
APH		1			1	
No	209 (93.72)	1,389 (96.93)	1.00 [referent]	T	1.00 [referent]	T
Yes	14 (6.28)	44 (3.07)	5.96 [0.95-37.40]	0.0568	1.56 [0.59-4.15]	0.3677
Placenta Praevia ^a	1					
No	223 (100.00)	1,423 (99.30)				
Yes	0 (0.00)	10 (0.70)				
Placental Abruption a						
No	221 (99.10)	1,429 (99.72)				
⁄es	2 (0.90)	4 (0.28)				
Fetal Distress						
No	195 (87.44)	1,323 (92.32)	1.00 [referent]		1.00 [referent]	
Yes	28 (12.56)	110 (7.68)	3.03 [0.90-10.23]	0.0735	1.56 [0.59-4.15]	0.3677
Cephalopelvic Dispropo	rtion ^a					
No	223 (100.00)	1,429 (99.72)				
Yes	0 (0.00)	4 (0.28)				
Prolapsed Cord ^a						

No	220 (98.65)	1,423 (99.30)				
Yes	3 (1.35)	10 (0.70)				
Precipitate Delivery a						
No	219 (98.21)	1,411 (98.46)				
Yes	4 (1.79)	22 (1.54)				
PPH ≥500mls						
No	141 (63.23)	1,058 (73.83)	1.00 [referent]		1.00 [referent]	
Yes	82 (36.77)	375 (26.17)	3.43 [1.49-7.94]	0.0040	1.38 [0.16-11.79]	0.7661
TSR ≥2mins						
No	183 (82.06)	1,241 (86.60)	1.00 [referent]		1.00 [referent]	
Yes	40 (17.94)	192 (13.40)	1.78 [0.81-3.89]	0.1486	0.91 [0.30-2.72]	0.8631
Apgar 5-minutes <7 a						
No	219 (98.21)	1,404 (97.98)				
Yes	4 (1.79)	29 (2.02)				
Intubation	, , ,					
No	178 (79.82)	1,211 (84.51)	1.00 [referent]		1.00 [referent]	
Yes	45 (20.18)	222 (15.49)	1.91 [0.90-4.05]	0.0931	1.53 [0.54-4.35]	0.4290
Early Preterm Birth		, ,		ı		1
No	172 (77.13)	1,238 (86.39)	1.00 [referent]		1.00 [referent]	
Yes	51 (22.87)	195 (13.61)	4.18 [1.50-11.67]	0.0064	2.06 [0.64-6.58]	0.2243
POBW <15 th Percentile	, , ,	4				
No	162 (72.65)	1,069 (74.60)	1.00 [referent]		1.00 [referent]	
Yes	42 (18.83)	175 (12.21)	2.72 [1.25-5.93]	0.0119	3.11 [1.26-7.64]	0.0136
Unavailable	19 (8.52)	189 (13.19)				
Parity	, , ,					
0	79 (35.43)	583 (40.68)	1.00 [referent]		1.00 [referent]	
1	73 (32.74)	510 (35.59)	1.18 [0.51-2.76]	0.7002	1.12 [0.31-4.04]	0.8612
≥2	71 (31.84)	340 (23.73)	2.66 [1.04-6.83]	0.0420	3.61 [0.61-21.22]	0.1551
Child	, ,	,	-			
Sex			· Y/			
Female	83 (37.22)	767 (53.52)	1.00 [referent]		1.00 [referent]	
Male	140 (62.78)	666 (46.48)	5.42 [2.79-10.55]	<0.0001	7.87 [3.45-17.97]	<0.0001
Ethnicity	, ,		N.			
Other	197 (88.34)	1,375 (95.95)	1.00 [referent]		1.00 [referent]	
Indigenous Australian	26 (11.66)	58 (4.05)	11.00 [2.78-43.60]	0.0007	2.32 [0.32-16.84]	0.4037
Child Speaks Language (
No	192 (86.10)	1,324 (92.39)	1.00 [referent]		1.00 [referent]	
Yes	31 (13.90)	109 (7.61)	3.19 [0.96-10.63]	0.0589	4.65 [1.14-19.03]	0.0330
Age Category at Time of	AEDC Complet	ion				
1	66 (29.60)	255 (17.79)	4.11 [1.80-9.39]	0.0008	5.36 [1.94-14.82]	0.0013
2	142 (63.68)	1,057 (73.76)	1.00 [referent]		1.00 [referent]	
3	15 (6.73)	121 (8.44)	0.95 [0.26-3.46]	0.9416	0.28 [0.05-1.70]	0.1672
Total Number of Sibling	S					•
1	58 (26.01)	450 (31.40)	1.00 [referent]		1.00 [referent]	
2	84 (37.67)	570 (39.78)	1.35 [0.57-3.19]	0.4887	1.26 [0.34-4.71]	0.7326
3	38 (17.04)	276 (19.26)	1.14 [0.40-3.24]	0.8098	0.47 [0.08-2.70]	0.3953
>3	43 (19.28)	137 (9.56)	7.14 [2.24-22.72]	0.0009	2.52 [0.34-18.73]	0.3659
Sociodemographic	, , , , , , ,					
Index of Relative Socioe	conomic Disad	vantage				
Lowest Quintile	175 (78.48)	1,198 (83.60)	2.14 [0.76-6.02]	0.1510	0.68 [0.21-2.25]	0.5294
> Lowest Quintile	39 (17.49)	198 (13.82)	1.00 [referent]		1.00 [referent]	<u>-</u>
Unavailable	9 (4.04)	37 (2.58)				
Excluded from multivari	_ , ,					

^a Excluded from multivariable analysis due to small N.

^b Age categories classified as; ≥3 years 10 months to <5 years and one month, 2) ≥5 years and one month to <5 years and 10 months (reference category), 3) ≥5 years and 10 months to <6 years 10 months.

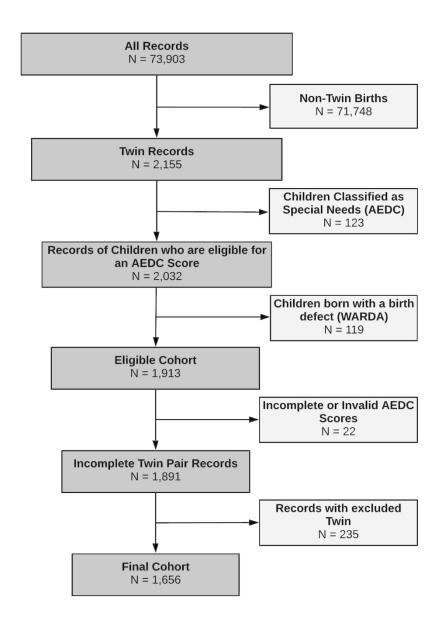


Figure 1. Eligible Cohort and Numbers Included for Analyses.AEDC = Australian Early Development Census. WARDA= Western Australian Register of Developmental Anomalies.

132x182mm (300 x 300 DPI)

Supplementary Tables and Figures (Total: 5 tables, 0 figures)

Table 1. Risk Factors for Developmental Vulnerability on the Physical Health & Wellbeing Domain.

Table 1. Risk Factors				ai Health		nain.
Cl	DV	NDV	Bivariate		Multivariable	
Characteristic	(N=188)	(N=1,468)	OD [050/ CI]	1 .	(N=1,352)	1 .
	N (%)	N (%)	OR [95% CI]	p-value	aOR [95% CI]	p-value
Maternal						
Age at Time of Child's B		T	T		T	
<25	46 (24.47)	176 (11.99)	5.36 [1.64-17.48]	0.0018	3.59 [0.93-13.90]	0.0646
25-29	39 (20.74)	345 (23.50)	1.00 [referent]		1.00 [referent]	
30-34	62 (32.98)	544 (37.06)	1.08 [0.41-2.87]	0.6456	1.13 [0.39-3.25]	0.8209
≥35	41 (21.81)	403 (27.45)	0.83 [0.29-2.38]	0.7761	0.97 [0.30-3.13]	0.9589
Marital Status						
Married (inc. de facto)	152 (80.85)	1,328 (90.46)	1.00 [referent]		1.00 [referent]	
All Other	36 (19.15)	134 (9.13)	5.54 [1.87-16.35]	0.0020	2.39 [0.66-8.70]	0.1847
Unavailable	0 (0.00)	6 (0.41)				
Occupational Status Sca	le at Time of Ch	ild's Birth				
0-20	52 (27.66)	257 (17.51)	3.29 [1.40-7.75]	0.0250	0.79 [0.28-2.27]	0.6631
>20-100	119 (63.30)	1,166 (79.43)	1.00 [referent]		1.00 [referent]	
Unavailable	17 (9.04)	45 (3.07)				
Pregnancy & Birth						
Fertility Treatments						
No	163 (86.70)	1,225 (83.45)	1.00 [referent]		1.00 [referent]	
Yes	25 (13.30)	243 (16.55)	0.61 [0.21-1.75]	0.3594	1.07 [0.32-3.62]	0.9141
Smoking Status During I	Pregnancy		·		· -	•
No	134 (71.28)	1,284 (87.47)	1.00 [referent]		1.00 [referent]	
Yes	54 (28.72)	184 (12.53)	7.19 [2.76-18.70]	<0.0001	2.49 [0.83-7.51]	0.1047
Pre-eclampsia	, ,	, ,	-			
No	163 (86.70)	1,297 (88.35)	1.00 [referent]		1.00 [referent]	
Yes	25 (13.30)	171 (11.65)	1.56 [0.46-5.24]	0.4752	2.99 [0.90-9.91]	0.0736
Gestational Diabetes	(,	1 = (==:=)	[0.10 0.11]	1		1 0.0.00
No	173 (92.02)	1,381 (94.07)	1.00 [referent]		1.00 [referent]	
Yes	15 (7.98)	87 (5.93)	1.87 [0.36-9.87]	0.4596	2.26 [0.50-10.20]	0.2903
Threatened Abortion	120 (7.130)	(0.00)	1.0. [0.00 5.0.7]	01.000		0.2300
No	182 (96.81)	1,390 (94.69)	1.00 [referent]		1.00 [referent]	
Yes	6 (3.19)	78 (5.31)	0.45 [0.07-2.71]	0.3787	0.43 [0.05-3.77]	0.4425
Other Pregnancy Relate			0.15 [0.07 2.71]	0.5707	0.15 [0.05 5.77]	0.1123
No	51 (27.13)	525 (35.76)	1.00 [referent]		1.00 [referent]	
Yes	137 (72.87)	943 (64.24)	1.96 [0.87-4.42]	0.1025	1.69 [0.65-4.42]	0.2835
Threatened Preterm Lai		343 (04.24)	1.50 [0.07 4.42]	0.1023	1.03 [0.03 4.42]	0.2033
No	161 (85.64)	1,303 (88.76)	1.00 [referent]		1.00 [referent]	
Yes	27 (14.36)	165 (11.24)	1.68 [0.49-5.81]	0.4108	0.86 [0.26-2.82]	0.7969
APH	27 (14.30)	103 (11.24)	1.00 [0.43-3.01]	0.4100	0.00 [0.20-2.02]	0.7303
No	178 (94.68)	1,420 (96.73)	1.00 [referent]		1.00 [referent]	
Yes	10 (5.32)	48 (3.27)	3.27 [0.37-28.63]	0.2850	0.73 [0.09-5.96]	0.7661
Placenta Praevia ^a	10 (3.32)	+0 (3.27)	3.27 [0.37-20.03]	0.2030	0.73 [0.03-3.36]	0.7001
	197 (00 47)	1 450 (00 20)				
No	187 (99.47)	1,459 (99.39)				
Yes	1 (0.53)	9 (0.61)				
Placental Abruption a	105 (00 40)	1 405 (00 0)				
No	185 (98.40)	1,465 (99.8)				
Yes Fatal Biotrope	3 (1.60)	3 (0.20)				
Fetal Distress	162 (06 17)	4 256 (02 27)	4.00 [#=f==== 1]		1.00 [===================================	
No	162 (86.17)	1,356 (92.37)	1.00 [referent]	0.000=	1.00 [referent]	0.4450
Yes	26 (13.83)	112 (7.63)	4.89 [1.20-19.90]	0.0267	2.57 [0.72-9.19]	0.1450
Cephalopelvic Dispropo		4.65 (55 ==:				
No	188 (100.00)	1,464 (99.73)				
Yes	0 (0.00)	4 (0.27)				
Prolapsed Cord a	1	I				
No	188 (100.00)	1,455 (99.11)				

	1	1				
Yes	0 (0.00)	13 (0.89)				
Precipitate Delivery a						
No	186 (98.94)	1,444 (98.37)				
Yes	2 (1.06)	24 (1.63)				
PPH ≥500mls						·
No	124 (65.96)	1,075 (73.23)	1.00 [referent]		1.00 [referent]	
Yes	64 (34.04)	393 (26.77)	2.16 [0.90-5.18]	0.0839	0.90 [0.36-2.25]	0.8256
TSR ≥2mins	, ,	,				
No	152 (80.85)	1,272 (86.65)	1.00 [referent]		1.00 [referent]	
Yes	36 (19.15)	196 (13.35)	1.48 [0.64-3.44]	0.3631	0.55 [0.19-1.55]	0.2581
Apgar 5-minutes <7 a	30 (13.13)	130 (13.33)	1.40 [0.04 3.44]	0.3031	0.55 [0.15 1.55]	0.2301
No	182 (96.81)	1,441 (98.16)				
Yes	6 (3.19)	27 (1.84)				
Intubation	0 (3.19)	27 (1.04)				
	147 (70 10)	1 242 (04 (0)	1 00 [nofement]		1 00 [nofement]	
No	147 (78.19)	1,242 (84.60)	1.00 [referent]	0.0407	1.00 [referent]	0.4670
Yes	41 (21.81)	226 (15.40)	2.33 [1.03-5.28]	0.0427	1.96 [0.75-5.10]	0.1670
Early Preterm Birth	4.46 (77.66)	4.264/264	4.00 [[.1		1.00 [[:1	
No	146 (77.66)	1,264 (86.1)	1.00 [referent]	T	1.00 [referent]	1
Yes	42 (22.34)	204 (13.9)	3.76 [1.21-11.68]	0.0223	2.15 [0.76-6.11]	0.1511
POBW <15 th Percentile						
No	125 (66.49)	1,106 (75.34)	1.00 [referent]	1	1.00 [referent]	
Yes	42 (22.34)	175 (11.92)	3.44 [1.53-7.74]	0.0029	2.58 [1.15-5.77]	0.0216
Unavailable	21 (11.17)	187 (12.74)				
Parity						
0	67 (35.64)	595 (40.53)	1.00 [referent]		1.00 [referent]	
1	65 (34.57)	518 (35.29)	1.18 [0.48-2.86]	0.7211	1.29 [0.41-4.08]	0.6653
≥2	56 (29.79)	355 (24.18)	1.81 [0.67-4.91]	0.2443	1.53 [0.29-8.17]	0.6173
Child	<u> </u>					
Sex						
Female	82 (43.62)	768 (52.32)	1.00 [referent]		1.00 [referent]	
Male	106 (56.38)	700 (47.68)	2.50 [1.36-4.61]	0.0034	3.31 [1.64-6.69]	0.0009
Ethnicity	1200 (00.00)	700 (11100)			0.02 (2.0 : 0.00)	1 0.0000
Other	167 (88.83)	1,405 (95.71)	1.00 [referent]		1.00 [referent]	
Indigenous Australian	21 (11.17)	63 (4.29)	12.56 [2.12-74.52]	0.0054	0.80 [0.12-5.40]	0.8160
Child Speaks Language	· · · · · ·	. ,	12.30 [2.12-74.32]	0.0034	0.80 [0.12-3.40]	0.8100
	_	1,357 (92.44)	1 00 [referent]		1 00 [referent]	
No	159 (84.57)	<u> </u>	1.00 [referent]	0.0220	1.00 [referent]	0.0163
Yes	29 (15.43)	111 (7.56)	4.62 [1.24-17.26]	0.0230	4.84 [1.34-17.48]	0.0162
Age Category at Time o			0 =0 [4 00 = 40]		2 22 [2 22 5 23]	0.0047
1	50 (26.60)	271 (18.46)	2.76 [1.02-7.46]	0.0008	2.22 [0.88-5.60]	0.0917
2	129 (68.62)	1,070 (72.89)	1.00 [referent]		1.00 [referent]	
3	9 (4.79)	127 (8.65)	0.44 [0.10-1.93]	0.9416	0.19 [0.03-1.18]	0.0739
Total Number of Sibling	<u></u>	T			T	
1	51 (27.13)	457 (31.13)	1.00 [referent]		1.00 [referent]	
2	69 (36.70)	585 (39.85)	1.10 [0.46-2.63]	0.8273	0.98 [0.30-3.15]	0.9697
3	24 (12.77)	290 (19.75)	0.51 [0.16-1.57]	0.2387	0.41 [0.08-2.10]	0.2836
>3	44 (23.40)	136 (9.26)	8.32 [2.57-26.96]	0.0004	6.47 [0.98-42.75]	0.0525
Sociodemographic						
Index of Relative Socioe	economic Disad	vantage				
Lowest Quintile	138 (73.40)	1,235 (84.13)	3.78 [1.17-12.22]	0.0261	1.85 [0.63-5.44]	0.2639
> Lowest Quintile	40 (21.28)	197 (13.42)	1.00 [referent]	•	1.00 [referent]	•
Unavailable	10 (5.32)	36 (2.45)				
	1 1	1 , -,				

^a Excluded from multivariable analysis due to small N.

^b Age categories classified as; ≥3 years 10 months to <5 years and one month, 2) ≥5 years and one month to <5 years and 10 months (reference category), 3) ≥5 years and 10 months to <6 years 10 months.

Table 2. Risk Factors for Developmental Vulnerability on the Social Competence Domain.

	DV	NDV	Bivariate		Multivariable	
Characteristic	(N=151)	(N=1,505)			(N=1,352)	
	N (%)	N (%)	OR [95% CI]	p-value	aOR [95% CI]	p-value
Maternal						
Age at Time of Child's B	irth (years)					
<25	43 (28.48)	179 (11.89)	6.32 [1.91-20.95]	0.0026	3.13 [0.74-13.30]	0.1219
25-29	31 (20.53)	353 (23.46)	1.00 [referent]		1.00 [referent]	
30-34	44 (29.14)	562 (37.34)	0.78 [0.29-2.15]	0.6340	1.36 [0.43-4.36]	0.6038
≥35	33 (21.85)	411 (27.31)	0.81 [0.27-2.37]	0.6955	0.99 [0.27-3.59]	0.9822
Marital Status			1 1	1	1 1	
Married (inc. de facto)	113 (74.83)	1,367 (90.83)	1.00 [referent]		1.00 [referent]	
All Other	36 (23.84)	134 (8.90)	9.65 [3.20-29.05]	<0.0001	10.16 [2.56-40.41]	0.0010
Unavailable	2 (1.32)	4 (0.27)	3.00 [0.20 23.03]	10.0002	20120 [2.00 10112]	1 0.0020
Occupational Status Sca						
0-20	50 (33.11)	259 (17.21)	5.05 [2.07-12.29]	0.0004	1.93 [0.64-5.79]	0.2414
>20-100	94 (62.25)	1,191 (79.14)	1.00 [referent]	0.0004	1.00 [referent]	0.2414
Unavailable	· · ·		1.00 [referent]		1.00 [referent]	
	7 (4.64)	55 (3.65)				
Pregnancy & Birth						
Fertility Treatments	122 (07.42)	1 250 (02 40)	4.00 [0-f 1]		4.00 [#-f 1]	
No	132 (87.42)	1,256 (83.46)	1.00 [referent]	0.3666	1.00 [referent]	0.624
Yes	19 (12.58)	249 (16.54)	0.54 [0.18-1.60]	0.2688	1.38 [0.37-5.17]	0.6347
Smoking Status During		4 202 (25 71)	4.00 [4.00 [5 :2	
No	116 (76.82)	1,302 (86.51)	1.00 [referent]		1.00 [referent]	1
Yes	35 (23.18)	203 (13.49)	3.70 [1.06-12.91]	0.0406	1.22 [0.35-4.20]	0.7525
Pre-eclampsia						
No	134 (88.74)	1,326 (88.11)	1.00 [referent]		1.00 [referent]	
Yes	17 (11.26)	179 (11.89)	0.98 [0.31-3.14]	0.9754	1.84 [0.49-6.84]	0.3645
Gestational Diabetes						
No	140 (92.72)	1,414 (93.95)	1.00 [referent]		1.00 [referent]	
Yes	11 (7.28)	91 (6.05)	1.46 [0.32-6.60]	0.6268	2.11 [0.41-10.74]	0.3692
Threatened Abortion						
No	144 (95.36)	1,428 (94.88)	1.00 [referent]		1.00 [referent]	
Yes	7 (4.64)	77 (5.12)	0.66 [0.11-4.10]	0.6579	0.13 [0.01-2.43]	0.1714
Other Pregnancy Relate	<u> </u>	<u> </u>	0.00 [0.1220]	0.0075	0.10 [0.01 10]	1 0.127 2
		538 (35.75)	1.00 [referent]		1.00 [referent]	
Yes	113 (74.83)	967 (64.25)	2.15 [0.89-5.19]	0.0884	2.00 [0.70-5.74]	0.1960
Threatened Preterm Lal		307 (04.23)	2.13 [0.03 3.13]	0.0004	2.00 [0.70 3.74]	0.1300
No	131 (86.75)	1,333 (88.57)	1.00 [referent]		1.00 [referent]	
	20 (13.25)	172 (11.43)	1.32 [0.42-4.17]	0.6403	0.69 [0.19-2.59]	0.5839
Yes APH	_ ZU (13.23)	1/2 (11.43)	1.32 [0.42-4.17]	0.0403	0.03 [0.13-2.33]	0.5835
	1/12 (0/1 0/1)	1,456 (96.74)	1 00 [referent]		1 00 [roforon+]	
No Vac	142 (94.04)		1.00 [referent]	0.1507	1.00 [referent]	0.472.4
Yes	9 (5.96)	49 (3.26)	3.74 [0.62-22.66]	0.1507	2.12 [0.27-16.50]	0.4734
Placenta Praevia a	454 (400 00)	4.405 (00.04)				
No	151 (100.00)	1,495 (99.34)				
Yes	0 (0.00)	10 (0.66)				
Placental Abruption ^a	T	T				
No	149 (98.68)	1,501 (99.73)				
Yes	2 (1.32)	4 (0.27)				
Fetal Distress						
No	132 (87.42)	1,386 (92.09)	1.00 [referent]		1.00 [referent]	
Yes	19 (12.58)	119 (7.91)	2.77 [0.81-9.50]	0.1045	1.39 [0.33-5.82]	0.6558
Cephalopelvic Dispropo	ortion ^a		·			
No	151 (100.00)	1,501 (99.73)				
Yes	0 (0.00)	4 (0.27)				
Prolapsed Cord ^a	1 - (00)	· (/				
No	148 (98.01)	1,495 (99.34)				
	3 (1.99)	10 (0.66)				
Yes	O (1.33)	TO (0.00)				

Precipitate Delivery a						
No	149 (98.68)	1,481 (98.41)				
Yes	2 (1.32)	24 (1.59)				
PPH ≥500mls				•		
No	96 (63.58)	1,103 (73.29)	1.00 [referent]		1.00 [referent]	
Yes	55 (36.42)	402 (26.71)	2.61 [1.14-5.97]	0.0233	1.42 [0.54-3.76]	0.4770
TSR ≥2mins		,				
No	119 (78.81)	1,305 (86.71)	1.00 [referent]		1.00 [referent]	
Yes	32 (21.19)	200 (13.29)	1.76 [0.80-3.89]	0.1607	0.80 [0.26-2.46]	0.6967
Apgar 5-minutes <7 a	,	, ,	-			
No	147 (97.35)	1,476 (98.07)				
Yes	4 (2.65)	29 (1.93)				
Intubation		, ,				
No	112 (74.17)	1,277 (84.85)	1.00 [referent]		1.00 [referent]	
Yes	39 (25.83)	228 (15.15)	2.31 [1.00-5.33]	0.0505	2.48 [0.86-7.20]	0.0934
Early Preterm Birth		, ,				
No	123 (81.46)	1,287 (85.51)	1.00 [referent]		1.00 [referent]	
Yes	28 (18.54)	218 (14.49)	1.64 [0.59-4.57]	0.3453	0.68 [0.20-2.27]	0.5254
POBW <15 th Percentile				•		•
No	114 (75.5)	1,117 (74.22)	1.00 [referent]		1.00 [referent]	
Yes	23 (15.23)	194 (12.89)	1.51 [0.65-3.54]	0.3408	1.65 [0.63-4.30]	0.3039
Unavailable	14 (9.27)	194 (12.89)		•		
Parity						
0	58 (38.41)	604 (40.13)	1.00 [referent]		1.00 [referent]	
1	49 (32.45)	534 (35.48)	1.06 [0.44-2.56]	0.9059	0.87 [0.25-3.08]	0.8268
	44 (20 44)	267 (24 20)	4 72 [0 67 4 50]	0.0500	2 02 [0 05 44 60]	1
≥2	44 (29.14)	367 (24.39)	1.73 [0.67-4.50]	0.2588	2.02 [0.35-11.63]	0.4317
≥2 Child	44 (29.14)	367 (24.39)	1.73 [0.67-4.50]	0.2588	2.02 [0.35-11.63]	0.4317
	44 (29.14)	367 (24.39)	1./3 [0.6/-4.50]	0.2588	2.02 [0.35-11.63]	0.4317
Child	51 (33.77)	799 (53.09)	1.00 [referent]	0.2588	1.00 [referent]	0.4317
Child Sex				<0.0001		<0.0001
Child Sex Female	51 (33.77)	799 (53.09)	1.00 [referent]		1.00 [referent]	
Child Sex Female Male	51 (33.77)	799 (53.09)	1.00 [referent]		1.00 [referent]	
Child Sex Female Male Ethnicity	51 (33.77) 100 (66.23)	799 (53.09) 706 (46.91)	1.00 [referent] 5.21 [2.58-10.52]		1.00 [referent] 5.35 [2.38-12.00]	
Child Sex Female Male Ethnicity Other	51 (33.77) 100 (66.23) 137 (90.73) 14 (9.27)	799 (53.09) 706 (46.91) 1,435 (95.35) 70 (4.65)	1.00 [referent] 5.21 [2.58-10.52] 1.00 [referent]	<0.0001	1.00 [referent] 5.35 [2.38-12.00] 1.00 [referent]	<0.0001
Child Sex Female Male Ethnicity Other Indigenous Australian	51 (33.77) 100 (66.23) 137 (90.73) 14 (9.27)	799 (53.09) 706 (46.91) 1,435 (95.35) 70 (4.65)	1.00 [referent] 5.21 [2.58-10.52] 1.00 [referent]	<0.0001	1.00 [referent] 5.35 [2.38-12.00] 1.00 [referent]	<0.0001
Child Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language (51 (33.77) 100 (66.23) 137 (90.73) 14 (9.27) Other Than Engl	799 (53.09) 706 (46.91) 1,435 (95.35) 70 (4.65) ish at Home	1.00 [referent] 5.21 [2.58-10.52] 1.00 [referent] 3.96 [0.86-18.29]	<0.0001	1.00 [referent] 5.35 [2.38-12.00] 1.00 [referent] 2.43 [0.36-16.63]	<0.0001
Child Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language (No	51 (33.77) 100 (66.23) 137 (90.73) 14 (9.27) Other Than Engl 139 (92.05) 12 (7.95)	799 (53.09) 706 (46.91) 1,435 (95.35) 70 (4.65) ish at Home 1,377 (91.50) 128 (8.50)	1.00 [referent] 5.21 [2.58-10.52] 1.00 [referent] 3.96 [0.86-18.29] 1.00 [referent]	<0.0001 0.0777	1.00 [referent] 5.35 [2.38-12.00] 1.00 [referent] 2.43 [0.36-16.63] 1.00 [referent]	<0.0001 0.3644
Child Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language (No Yes	51 (33.77) 100 (66.23) 137 (90.73) 14 (9.27) Other Than Engl 139 (92.05) 12 (7.95)	799 (53.09) 706 (46.91) 1,435 (95.35) 70 (4.65) ish at Home 1,377 (91.50) 128 (8.50)	1.00 [referent] 5.21 [2.58-10.52] 1.00 [referent] 3.96 [0.86-18.29] 1.00 [referent]	<0.0001 0.0777	1.00 [referent] 5.35 [2.38-12.00] 1.00 [referent] 2.43 [0.36-16.63] 1.00 [referent]	<0.0001 0.3644
Child Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language C No Yes Age Category at Time of 1 2	51 (33.77) 100 (66.23) 137 (90.73) 14 (9.27) Other Than Engl 139 (92.05) 12 (7.95) AEDC Completi	799 (53.09) 706 (46.91) 1,435 (95.35) 70 (4.65) ish at Home 1,377 (91.50) 128 (8.50)	1.00 [referent] 5.21 [2.58-10.52] 1.00 [referent] 3.96 [0.86-18.29] 1.00 [referent] 0.67 [0.17-2.62] 2.42 [0.98-5.94] 1.00 [referent]	< 0.0001 0.0777 0.5667	1.00 [referent] 5.35 [2.38-12.00] 1.00 [referent] 2.43 [0.36-16.63] 1.00 [referent] 1.13 [0.24-5.18]	<0.0001 0.3644 0.8797
Child Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language C No Yes Age Category at Time of	51 (33.77) 100 (66.23) 137 (90.73) 14 (9.27) Other Than Engl 139 (92.05) 12 (7.95) AEDC Completi 40 (26.49)	799 (53.09) 706 (46.91) 1,435 (95.35) 70 (4.65) ish at Home 1,377 (91.50) 128 (8.50) ion ^b 281 (18.67)	1.00 [referent] 5.21 [2.58-10.52] 1.00 [referent] 3.96 [0.86-18.29] 1.00 [referent] 0.67 [0.17-2.62] 2.42 [0.98-5.94]	< 0.0001 0.0777 0.5667	1.00 [referent] 5.35 [2.38-12.00] 1.00 [referent] 2.43 [0.36-16.63] 1.00 [referent] 1.13 [0.24-5.18] 2.84 [1.05-7.73]	<0.0001 0.3644 0.8797
Child Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language C No Yes Age Category at Time of 1 2	51 (33.77) 100 (66.23) 137 (90.73) 14 (9.27) Other Than Engl 139 (92.05) 12 (7.95) AEDC Completi 40 (26.49) 98 (64.9) 13 (8.61)	799 (53.09) 706 (46.91) 1,435 (95.35) 70 (4.65) ish at Home 1,377 (91.50) 128 (8.50) ion ^b 281 (18.67) 1,101 (73.16)	1.00 [referent] 5.21 [2.58-10.52] 1.00 [referent] 3.96 [0.86-18.29] 1.00 [referent] 0.67 [0.17-2.62] 2.42 [0.98-5.94] 1.00 [referent] 1.73 [0.46-6.48]	0.0777 0.5667 0.0547	1.00 [referent] 5.35 [2.38-12.00] 1.00 [referent] 2.43 [0.36-16.63] 1.00 [referent] 1.13 [0.24-5.18] 2.84 [1.05-7.73] 1.00 [referent] 0.51 [0.09-2.75]	<0.0001 0.3644 0.8797 0.0406
Child Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language C No Yes Age Category at Time of 1 2 3 Total Number of Sibling	51 (33.77) 100 (66.23) 137 (90.73) 14 (9.27) Other Than Engl 139 (92.05) 12 (7.95) AEDC Completi 40 (26.49) 98 (64.9) 13 (8.61)	799 (53.09) 706 (46.91) 1,435 (95.35) 70 (4.65) ish at Home 1,377 (91.50) 128 (8.50) ion ^b 281 (18.67) 1,101 (73.16) 123 (8.17) 467 (31.03)	1.00 [referent] 5.21 [2.58-10.52] 1.00 [referent] 3.96 [0.86-18.29] 1.00 [referent] 0.67 [0.17-2.62] 2.42 [0.98-5.94] 1.00 [referent] 1.73 [0.46-6.48] 1.00 [referent]	0.0001 0.0777 0.5667 0.0547	1.00 [referent] 5.35 [2.38-12.00] 1.00 [referent] 2.43 [0.36-16.63] 1.00 [referent] 1.13 [0.24-5.18] 2.84 [1.05-7.73] 1.00 [referent] 0.51 [0.09-2.75] 1.00 [referent]	<0.0001 0.3644 0.8797 0.0406 0.4309
Child Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language C No Yes Age Category at Time of 1 2 3 Total Number of Sibling 1 2	51 (33.77) 100 (66.23) 137 (90.73) 14 (9.27) Other Than Engl 139 (92.05) 12 (7.95) AEDC Complet 40 (26.49) 98 (64.9) 13 (8.61) S 41 (27.15) 57 (37.75)	799 (53.09) 706 (46.91) 1,435 (95.35) 70 (4.65) ish at Home 1,377 (91.50) 128 (8.50) on ^b 281 (18.67) 1,101 (73.16) 123 (8.17)	1.00 [referent] 5.21 [2.58-10.52] 1.00 [referent] 3.96 [0.86-18.29] 1.00 [referent] 0.67 [0.17-2.62] 2.42 [0.98-5.94] 1.00 [referent] 1.73 [0.46-6.48] 1.00 [referent] 1.27 [0.50-3.23]	0.0777 0.5667 0.0547	1.00 [referent] 5.35 [2.38-12.00] 1.00 [referent] 2.43 [0.36-16.63] 1.00 [referent] 1.13 [0.24-5.18] 2.84 [1.05-7.73] 1.00 [referent] 0.51 [0.09-2.75]	<0.0001 0.3644 0.8797 0.0406
Child Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language C No Yes Age Category at Time of 1 2 3 Total Number of Sibling	51 (33.77) 100 (66.23) 137 (90.73) 14 (9.27) Other Than Engl 139 (92.05) 12 (7.95) AEDC Complet 40 (26.49) 98 (64.9) 13 (8.61) S	799 (53.09) 706 (46.91) 1,435 (95.35) 70 (4.65) ish at Home 1,377 (91.50) 128 (8.50) ion ^b 281 (18.67) 1,101 (73.16) 123 (8.17) 467 (31.03)	1.00 [referent] 5.21 [2.58-10.52] 1.00 [referent] 3.96 [0.86-18.29] 1.00 [referent] 0.67 [0.17-2.62] 2.42 [0.98-5.94] 1.00 [referent] 1.73 [0.46-6.48] 1.00 [referent]	0.0001 0.0777 0.5667 0.0547	1.00 [referent] 5.35 [2.38-12.00] 1.00 [referent] 2.43 [0.36-16.63] 1.00 [referent] 1.13 [0.24-5.18] 2.84 [1.05-7.73] 1.00 [referent] 0.51 [0.09-2.75] 1.00 [referent]	<0.0001 0.3644 0.8797 0.0406 0.4309
Child Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language C No Yes Age Category at Time of 1 2 3 Total Number of Sibling 1 2	51 (33.77) 100 (66.23) 137 (90.73) 14 (9.27) Other Than Engl 139 (92.05) 12 (7.95) AEDC Complet 40 (26.49) 98 (64.9) 13 (8.61) S 41 (27.15) 57 (37.75)	799 (53.09) 706 (46.91) 1,435 (95.35) 70 (4.65) ish at Home 1,377 (91.50) 128 (8.50) ion b 281 (18.67) 1,101 (73.16) 123 (8.17) 467 (31.03) 597 (39.67)	1.00 [referent] 5.21 [2.58-10.52] 1.00 [referent] 3.96 [0.86-18.29] 1.00 [referent] 0.67 [0.17-2.62] 2.42 [0.98-5.94] 1.00 [referent] 1.73 [0.46-6.48] 1.00 [referent] 1.27 [0.50-3.23]	0.0777 0.5667 0.0547 0.4174	1.00 [referent] 5.35 [2.38-12.00] 1.00 [referent] 2.43 [0.36-16.63] 1.00 [referent] 1.13 [0.24-5.18] 2.84 [1.05-7.73] 1.00 [referent] 0.51 [0.09-2.75] 1.00 [referent] 1.97 [0.52-7.49]	<0.0001 0.3644 0.8797 0.0406 0.4309
Child Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language C No Yes Age Category at Time of 1 2 3 Total Number of Sibling 1 2 3	51 (33.77) 100 (66.23) 137 (90.73) 14 (9.27) Other Than Engl 139 (92.05) 12 (7.95) AEDC Complet 40 (26.49) 98 (64.9) 13 (8.61) S 41 (27.15) 57 (37.75) 27 (17.88)	799 (53.09) 706 (46.91) 1,435 (95.35) 70 (4.65) ish at Home 1,377 (91.50) 128 (8.50) ion b 281 (18.67) 1,101 (73.16) 123 (8.17) 467 (31.03) 597 (39.67) 287 (19.07)	1.00 [referent] 5.21 [2.58-10.52] 1.00 [referent] 3.96 [0.86-18.29] 1.00 [referent] 0.67 [0.17-2.62] 2.42 [0.98-5.94] 1.00 [referent] 1.73 [0.46-6.48] 1.00 [referent] 1.27 [0.50-3.23] 1.27 [0.41-3.91]	0.0777 0.5667 0.0547 0.4174 0.6133 0.6779	1.00 [referent] 5.35 [2.38-12.00] 1.00 [referent] 2.43 [0.36-16.63] 1.00 [referent] 1.13 [0.24-5.18] 2.84 [1.05-7.73] 1.00 [referent] 0.51 [0.09-2.75] 1.00 [referent] 1.97 [0.52-7.49] 0.91 [0.16-5.21]	<0.0001
Child Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language C No Yes Age Category at Time of 1 2 3 Total Number of Sibling 1 2 3 >3 Sociodemographic Index of Relative Socioe	51 (33.77) 100 (66.23) 137 (90.73) 14 (9.27) Other Than Engl 139 (92.05) 12 (7.95) AEDC Complet 40 (26.49) 98 (64.9) 13 (8.61) S 41 (27.15) 57 (37.75) 27 (17.88) 26 (17.22)	799 (53.09) 706 (46.91) 1,435 (95.35) 70 (4.65) ish at Home 1,377 (91.50) 128 (8.50) ion b 281 (18.67) 1,101 (73.16) 123 (8.17) 467 (31.03) 597 (39.67) 287 (19.07) 154 (10.23)	1.00 [referent] 5.21 [2.58-10.52] 1.00 [referent] 3.96 [0.86-18.29] 1.00 [referent] 0.67 [0.17-2.62] 2.42 [0.98-5.94] 1.00 [referent] 1.73 [0.46-6.48] 1.00 [referent] 1.27 [0.50-3.23] 1.27 [0.41-3.91]	0.0777 0.5667 0.0547 0.4174 0.6133 0.6779	1.00 [referent] 5.35 [2.38-12.00] 1.00 [referent] 2.43 [0.36-16.63] 1.00 [referent] 1.13 [0.24-5.18] 2.84 [1.05-7.73] 1.00 [referent] 0.51 [0.09-2.75] 1.00 [referent] 1.97 [0.52-7.49] 0.91 [0.16-5.21]	<0.0001
Child Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language C No Yes Age Category at Time of 1 2 3 Total Number of Sibling 1 2 3 >3 Sociodemographic	51 (33.77) 100 (66.23) 137 (90.73) 14 (9.27) Other Than Engl 139 (92.05) 12 (7.95) AEDC Complet 40 (26.49) 98 (64.9) 13 (8.61) S 41 (27.15) 57 (37.75) 27 (17.88) 26 (17.22)	799 (53.09) 706 (46.91) 1,435 (95.35) 70 (4.65) ish at Home 1,377 (91.50) 128 (8.50) ion b 281 (18.67) 1,101 (73.16) 123 (8.17) 467 (31.03) 597 (39.67) 287 (19.07) 154 (10.23)	1.00 [referent] 5.21 [2.58-10.52] 1.00 [referent] 3.96 [0.86-18.29] 1.00 [referent] 0.67 [0.17-2.62] 2.42 [0.98-5.94] 1.00 [referent] 1.73 [0.46-6.48] 1.00 [referent] 1.27 [0.50-3.23] 1.27 [0.41-3.91]	0.0777 0.5667 0.0547 0.4174 0.6133 0.6779	1.00 [referent] 5.35 [2.38-12.00] 1.00 [referent] 2.43 [0.36-16.63] 1.00 [referent] 1.13 [0.24-5.18] 2.84 [1.05-7.73] 1.00 [referent] 0.51 [0.09-2.75] 1.00 [referent] 1.97 [0.52-7.49] 0.91 [0.16-5.21] 2.53 [0.33-19.66] 0.72 [0.21-2.45]	<0.0001
Child Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language C No Yes Age Category at Time of 1 2 3 Total Number of Sibling 1 2 3 >3 Sociodemographic Index of Relative Socioe Lowest Quintile > Lowest Quintile	51 (33.77) 100 (66.23) 137 (90.73) 14 (9.27) Other Than Engl 139 (92.05) 12 (7.95) AEDC Complet 40 (26.49) 98 (64.9) 13 (8.61) s 41 (27.15) 57 (37.75) 27 (17.88) 26 (17.22) conomic Disady 118 (78.15) 26 (17.22)	799 (53.09) 706 (46.91) 1,435 (95.35) 70 (4.65) ish at Home 1,377 (91.50) 128 (8.50) on b 281 (18.67) 1,101 (73.16) 123 (8.17) 467 (31.03) 597 (39.67) 287 (19.07) 154 (10.23) rantage 1,255 (83.39) 211 (14.02)	1.00 [referent] 5.21 [2.58-10.52] 1.00 [referent] 3.96 [0.86-18.29] 1.00 [referent] 0.67 [0.17-2.62] 2.42 [0.98-5.94] 1.00 [referent] 1.73 [0.46-6.48] 1.00 [referent] 1.27 [0.50-3.23] 1.27 [0.41-3.91] 4.06 [1.14-14.39]	0.0001 0.0777 0.5667 0.0547 0.4174 0.6133 0.6779 0.0303	1.00 [referent] 5.35 [2.38-12.00] 1.00 [referent] 2.43 [0.36-16.63] 1.00 [referent] 1.13 [0.24-5.18] 2.84 [1.05-7.73] 1.00 [referent] 0.51 [0.09-2.75] 1.00 [referent] 1.97 [0.52-7.49] 0.91 [0.16-5.21] 2.53 [0.33-19.66]	0.3644 0.8797 0.0406 0.4309 0.3223 0.9149 0.3737
Child Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language C No Yes Age Category at Time of 1 2 3 Total Number of Sibling 1 2 3 >3 Sociodemographic Index of Relative Socioe Lowest Quintile	51 (33.77) 100 (66.23) 137 (90.73) 14 (9.27) Other Than Engl 139 (92.05) 12 (7.95) AEDC Complet 40 (26.49) 98 (64.9) 13 (8.61) S 41 (27.15) 57 (37.75) 27 (17.88) 26 (17.22) conomic Disadv 118 (78.15) 26 (17.22) 7 (4.64)	799 (53.09) 706 (46.91) 1,435 (95.35) 70 (4.65) ish at Home 1,377 (91.50) 128 (8.50) ion b 281 (18.67) 1,101 (73.16) 123 (8.17) 467 (31.03) 597 (39.67) 287 (19.07) 154 (10.23) antage 1,255 (83.39) 211 (14.02) 39 (2.59)	1.00 [referent] 5.21 [2.58-10.52] 1.00 [referent] 3.96 [0.86-18.29] 1.00 [referent] 0.67 [0.17-2.62] 2.42 [0.98-5.94] 1.00 [referent] 1.73 [0.46-6.48] 1.00 [referent] 1.27 [0.50-3.23] 1.27 [0.41-3.91] 4.06 [1.14-14.39]	0.0001 0.0777 0.5667 0.0547 0.4174 0.6133 0.6779 0.0303	1.00 [referent] 5.35 [2.38-12.00] 1.00 [referent] 2.43 [0.36-16.63] 1.00 [referent] 1.13 [0.24-5.18] 2.84 [1.05-7.73] 1.00 [referent] 0.51 [0.09-2.75] 1.00 [referent] 1.97 [0.52-7.49] 0.91 [0.16-5.21] 2.53 [0.33-19.66] 0.72 [0.21-2.45]	0.3644 0.8797 0.0406 0.4309 0.3223 0.9149 0.3737

^a Excluded from multivariable analysis due to small N.

^b Age categories classified as; ≥3 years 10 months to <5 years and one month, 2) ≥5 years and one month to <5 years and 10 months (reference category), 3) \geq 5 years and 10 months to <6 years 10 months.

Table 3. Risk Factors for Developmental Vulnerability on the Emotional Maturity Domain.

	DV	NDV	Bivariate		Multivariable	
Characteristic	(N=147)	(N=1,509)			(N=1,352)	
	N (%)	N (%)	OR [95% CI]	p-value	aOR [95% CI]	p-value
Maternal						
Age at Time of Child's Bi	rth (years)					
<25	39 (26.53)	183 (12.13)	3.14 [1.44-6.89]	0.0042	1.89 [0.70-5.05]	0.2063
25-29	31 (21.09)	353 (23.39)	1.00 [referent]	•	1.00 [referent]	•
30-34	38 (25.85)	568 (37.64)	0.70 [0.35-1.40]	0.3113	1.03 [0.46-2.34]	0.9373
 ≥35	39 (26.53)	405 (26.84)	1.12 [0.55-2.27]	0.7615	1.16 [0.48-2.81]	0.7415
Marital Status		,				
Married (inc. de facto)	111 (75.51)	1,369 (90.72)	1.00 [referent]		1.00 [referent]	
All Other	34 (23.13)	136 (9.01)	4.58 [2.26-9.27]	<0.0001	3.77 [1.48-9.58]	0.0055
Unavailable	2 (1.36)	4 (0.27)				
Occupational Status Sca	<u> </u>					
0-20	45 (30.61)	264 (17.50)	2.62 [1.46-4.72]	0.0014	1.85 [0.86-3.97]	0.1131
>20-100	95 (64.63)	1,190 (78.86)	1.00 [referent]	1.0017	1.00 [referent]	1 3.1131
Unavailable	7 (4.76)	55 (3.64)	2.00 [referent]		1.00 [referent]	
Pregnancy & Birth	, (4.70)	J JJ (J.U 4)				
Fertility Treatments						
No	126 (85.71)	1,262 (83.63)	1.00 [referent]		1.00 [referent]	
Yes	21 (14.29)	247 (16.37)	0.81 [0.40-1.66]	0.5666	1.03 [0.42-2.53]	0.9569
Smoking Status During P		277 (10.37)	J.01 [0.40 ⁻ 1.00]	0.3000	1.00 [0.42-2.00]	1 0.2303
No	118 (80.27)	1,300 (86.15)	1.00 [referent]		1.00 [referent]	
Yes	29 (19.73)	209 (13.85)	1.70 [0.86-3.36]	0.1304	0.82 [0.33-2.02]	0.6620
	23 (13./3)	203 (13.63)	1.70 [0.00-3.30]	0.1304	0.02 [0.33-2.02]	0.0020
Pre-eclampsia	120 /07 70	1 221 (00 20)	1.00 [roforo=+1		1.00[rofor==+1	
No	129 (87.76)	1,331 (88.20)	1.00 [referent]	0.0373	1.00 [referent]	0.470
Yes	18 (12.24)	178 (11.80)	1.09 [0.50-2.40]	0.8272	1.87 [0.75-4.63]	0.1764
Gestational Diabetes	420 (02 00)	4.446.(02.04)	1 00 [4.00 [
No V	138 (93.88)	1,416 (93.84)	1.00 [referent]	0.0750	1.00 [referent]	0.701-
Yes	9 (6.12)	93 (6.16)	1.02 [0.35-2.97]	0.9752	1.18 [0.37-3.76]	0.7845
Threatened Abortion	1.10 (0= = :)	14.405.45.55	1,000		1.001.6	
No	140 (95.24)	1,432 (94.90)	1.00 [referent]	0.005	1.00 [referent]	6
Yes	7 (4.76)	77 (5.10)	0.91 [0.28-3.03]	0.8823	0.09 [0.01-1.06]	0.0553
Other Pregnancy Related		T			T	
		541 (35.85)	1.00 [referent]	1	1.00 [referent]	1
Yes	112 (76.19)	968 (64.15)	2.13 [1.20-3.80]	0.0101	1.80 [0.86-3.78]	0.1208
Threatened Preterm Lab	_				T	
No	125 (85.03)	1,339 (88.73)	1.00 [referent]		1.00 [referent]	
Yes	22 (14.97)	170 (11.27)	1.52 [0.72-3.25]	0.2742	1.21 [0.51-2.85]	0.6642
APH						
No	139 (94.56)	1,459 (96.69)	1.00 [referent]		1.00 [referent]	
Yes	8 (5.44)	50 (3.31)	2.13 [0.62-7.31]	0.2304	0.67 [0.13-3.31]	0.6180
Placenta Praevia a						
No	146 (99.32)	1,500 (99.40)				
Yes	1 (0.68)	9 (0.60)				
Placental Abruption a		•				
No	145 (98.64)	1,505 (99.73)				
Yes	2 (1.36)	4 (0.27)				
Fetal Distress		1 , ,				
No	128 (87.07)	1,390 (92.11)	1.00 [referent]		1.00 [referent]	
Yes	19 (12.93)	119 (7.89)	1.95 [0.86-4.44]	0.1107	1.09 [0.40-2.93]	0.8689
Cephalopelvic Dispropo	· · · · · · · · · · · · · · · · · · ·	1 225 (7.05)	1.55 [5.00 4.44]		1.03 [0.40 2.33]	1 3.3003
No	147 (100.00)	1,505 (99.73)				
Yes	0 (0.00)	4 (0.27)				
res Prolapsed Cord ^a	0 (0.00)	4 (0.27)				
•	145 (00 C4)	1 400 (00 27)				
No	145 (98.64) 2 (1.36)	1,498 (99.27) 11 (0.73)				
Yes						

Precipitate Delivery a						
No	146 (99.32)	1,484 (98.34)				
Yes	1 (0.68)	25 (1.66)				
PPH ≥500mls	(/	1 - (/				
No	95 (64.63)	1,104 (73.16)	1.00 [referent]		1.00 [referent]	
Yes	52 (35.37)	405 (26.84)	1.75 [1.01-3.05]	0.0473	1.03 [0.52-2.03]	0.9320
TSR ≥2mins	02 (00.07)	100 (20.0.)		0.0 0		0.5525
No	119 (80.95)	1,305 (86.48)	1.00 [referent]		1.00 [referent]	
Yes	28 (19.05)	204 (13.52)	1.69 [0.91-3.15]	0.0963	1.12 [0.45-2.74]	0.8123
Apgar 5-minutes <7 a	10 (10:00)	10:(10:01)	2.05 [0.02 0.20]	1 0.0000		0.0120
No	143 (97.28)	1,480 (98.08)				
Yes	4 (2.72)	29 (1.92)				
Intubation	. (2.72)	123 (1.32)				
No	114 (77.55)	1,275 (84.49)	1.00 [referent]		1.00 [referent]	
Yes	33 (22.45)	234 (15.51)	1.78 [0.98-3.21]	0.0572	1.48 [0.63-3.49]	0.3664
Early Preterm Birth	33 (22.13)	1231 (13.31)	1.70 [0.30 3.21]	0.0372	1.10 [0.03 3.13]	0.5001
No	119 (80.95)	1,291 (85.55)	1.00 [referent]		1.00 [referent]	
Yes	28 (19.05)	218 (14.45)	1.51 [0.76-3.00]	0.2372	0.95 [0.42-2.13]	0.8986
POBW <15 th Percentile		(,			0.00 [0.12 2.20]	
No	106 (72.11)	1,125 (74.55)	1.00 [referent]		1.00 [referent]	
Yes	24 (16.33)	193 (12.79)	1.48 [0.76-2.87]	0.2519	1.59 [0.77-3.30]	0.2103
Unavailable	17 (11.56)	191 (12.66)		0.2320		
Parity	()	(==:00)				
0	61 (41.5)	601 (39.83)	1.00 [referent]		1.00 [referent]	
1	52 (35.37)	531 (35.19)	0.99 [0.55-1.78]	0.9677	0.86 [0.36-2.03]	0.7233
≥2	34 (23.13)	377 (24.98)	0.89 [0.46-1.72]	0.7269	0.84 [0.24-2.95]	0.7858
Child		(2).00()				
Sex						
Female	32 (21.77)	818 (54.21)	1.00 [referent]		1.00 [referent]	
Male	115 (78.23)	691 (45.79)	10.13 [4.94-20.79]	<0.0001	9.37 [4.42-19.87]	<0.0001
Ethnicity	- (/	1 (/			1	
Other	131 (89.12)	1,441 (95.49)	1.00 [referent]		1.00 [referent]	
Indigenous Australian	16 (10.88)	68 (4.51)	3.62 [1.36-9.62]	0.0101	5.61 [1.48-21.31]	0.0115
Child Speaks Language O	<u> </u>			1		
No	135 (91.84)	1,381 (91.52)	1.00 [referent]		1.00 [referent]	
Yes	12 (8.16)	128 (8.48)	1.00 [0.40-2.49]	0.9937	1.02 [0.34-3.04]	0.9749
Age Category at Time of	· · ·			1		
1	37 (25.17)	284 (18.82)	1.57 [0.85-2.90]	0.1475	1.38 [0.68-2.80]	0.3767
2	102 (69.39)	1,097 (72.7)	1.00 [referent]		1.00 [referent]	
3	8 (5.44)	128 (8.48)	0.62 [0.22-1.77]	0.3720	0.31 [0.08-1.17]	0.0846
Total Number of Siblings		, ,	•			
1	45 (30.61)	463 (30.68)	1.00 [referent]		1.00 [referent]	
2	59 (40.14)	595 (39.43)	1.05 [0.57-1.95]	0.8726	1.72 [0.69-4.25]	0.2413
3	22 (14.97)	292 (19.35)	0.71 [0.32-1.57]	0.4004	0.95 [0.28-3.24]	0.9354
>3	21 (14.29)	159 (10.54)	1.62 [0.69-3.80]	0.2700	1.93 [0.46-8.19]	0.3703
Sociodemographic		, ,				
Index of Relative Socioed	conomic Disadva	ntage				
Lowest Quintile	118 (80.27)	1,255 (83.17)	1.08 [0.54-2.17]	0.8345	0.58 [0.24-1.43]	0.2376
> Lowest Quintile	22 (14.97)	215 (14.25)	1.00 [referent]	1	1.00 [referent]	1
Unavailable	7 (4.76)	39 (2.58)			,	
^a Excluded from multivaria						

^a Excluded from multivariable analysis due to small N.

^b Age categories classified as; ≥3 years 10 months to <5 years and one month, 2) ≥5 years and one month to <5 years and 10 months (reference category), 3) ≥5 years and 10 months to <6 years 10 months.

Table 4. Risk Factors for Developmental Vulnerability on the Language & Cognitive Skills (school-based) Domain.

based) Domain.						
	DV	NDV	Bivariate		Multivariable	
Characteristic	(N=195)	(N=1,461)		i	(N=1,352)	1
	N (%)	N (%)	OR [95% CI]	p-value	aOR [95% CI]	p-value
Maternal						
Age at Time of Child's B	1					
<25	68 (34.87)	154 (10.54)	18.41 [5.21-65.05]	<0.0001	12.90 [2.81-59.16]	0.0010
25-29	38 (19.49)	346 (23.68)	1.00 [referent]		1.00 [referent]	
30-34	52 (26.67)	554 (37.92)	0.72 [0.25-2.02]	0.5279	0.80 [0.24-2.67]	0.7162
≥35	37 (18.97)	407 (27.86)	0.70 [0.23-2.13]	0.5283	0.98 [0.27-3.57]	0.9697
Marital Status						
Married (inc. de facto)	145 (74.36)	1,335 (91.38)	1.00 [referent]		1.00 [referent]	
All Other	50 (25.64)	120 (8.21)	18.44 [5.70-59.63]	<0.0001	5.92 [1.43-24.59]	0.0144
Unavailable	0 (0.00)	6 (0.41)				
Occupational Status Sca	ale at Time of Ch	ild's Birth				
0-20	70 (35.90)	239 (16.36)	12.68 [4.58-35.09]	<0.0001	3.61 [1.19-10.95]	0.0235
>80-100	105 (53.85)	1,180 (80.77)	1.00 [referent]		1.00 [referent]	
Unavailable	20 (10.26)	42 (2.87)				
Pregnancy & Birth						
Fertility Treatments		4				
No	180 (92.31)	1,208 (82.68)	1.00 [referent]		1.00 [referent]	
Yes	15 (7.69)	253 (17.32)	0.16 [0.04-0.55]	0.0041	0.42 [0.09-1.95]	0.2644
Smoking Status During	Pregnancy					
No	145 (74.36)	1,273 (87.13)	1.00 [referent]		1.00 [referent]	
Yes	50 (25.64)	188 (12.87)	6.35 [2.24-18.01]	0.0005	0.28 [0.07-1.09]	0.0655
Pre-eclampsia				•		•
No	176 (90.26)	1,284 (87.89)	1.00 [referent]		1.00 [referent]	
Yes	19 (9.74)	177 (12.11)	0.61 [0.18-2.10]	0.4336	1.09 [0.26-4.60]	0.9080
Gestational Diabetes	,	,				
No	184 (94.36)	1,370 (93.77)	1.00 [referent]		1.00 [referent]	
Yes	11 (5.64)	91 (6.23)	0.84 [0.16-4.44]	0.8360	0.66 [0.11-4.01]	0.6511
Threatened Abortion	, ,		N.			
No	189 (96.92)	1,383 (94.66)	1.00 [referent]		1.00 [referent]	
Yes	6 (3.08)	78 (5.34)	0.36 [0.05-2.41]	0.2905	0.20 [0.01-3.32]	0.2578
Other Pregnancy Relate	<u> </u>					
	53 (27.18)	523 (35.80)	1.00 [referent]		1.00 [referent]	
Yes	142 (72.82)	938 (64.20)	1.96 [0.84-4.54]	0.1191	1.29 [0.45-3.71]	0.6348
Threatened Preterm La	· · · ·	1 000 (0 1120)				1 0100 10
No	162 (83.08)	1,302 (89.12)	1.00 [referent]		1.00 [referent]	
Yes	33 (16.92)	159 (10.88)	3.21 [0.80-12.92]	0.1002	1.20 [0.32-4.48]	0.7821
APH	33 (23.52)	1 200 (20.00)	0.22 [0.00 22.02]	0.1001		0.7.022
No	183 (93.85)	1,415 (96.85)	1.00 [referent]		1.00 [referent]	
Yes	12 (6.15)	46 (3.15)	6.80 [0.62-74.13]	0.1156	4.92 [0.62-39.01]	0.1315
Placenta Praevia	12 (0.13)	10 (3.13)	0.00 [0.02 7 1.13]	0.1130	1.52 [0.02 55.01]	0.1313
No	195 (100.00)	1,451 (99.32)				
Yes	0 (0.00)	10 (0.68)				
Placental Abruption	0 (0.00)	10 (0.00)				
No No	195 (100.00)	1,455 (99.59)				
Yes	0 (0.00)	6 (0.41)				
Fetal Distress	0 (0.00)	0 (0.41)				
No No	173 (88.72)	1,345 (92.06)	1.00 [referent]		1.00 [referent]	
	-		2.04 [0.45-9.17]	0.2524	0.56 [0.11-2.76]	0.4752
Yes Conhalonolyic Dispress	22 (11.28)	116 (7.94)	2.04 [0.45-9.17]	0.3531	U.30 [U.11-2./b]	0.4753
Cephalopelvic Dispropo	1	1 457 (00 73)				
No	195 (100.00)	1,457 (99.73)				
Yes	0 (0.00)	4 (0.27)				
Prolapsed Cord a	402 (22 :5)	4 454 (00 55)				
No	192 (98.46)	1,451 (99.32)				

Yes	3 (1.54)	10 (0.68)				
Precipitate Delivery a						
No	190 (97.44)	1,440 (98.56)				
Yes	5 (2.56)	21 (1.44)				
PPH ≥500mls	•	•				
No	123 (63.08)	1,076 (73.65)	1.00 [referent]		1.00 [referent]	
Yes	72 (36.92)	385 (26.35)	3.13 [1.22-8.05]	0.0177	1.84 [0.67-5.03]	0.2374
TSR ≥2mins	(/	1 ()				
No	163 (83.59)	1,261 (86.31)	1.00 [referent]		1.00 [referent]	
Yes	32 (16.41)	200 (13.69)	0.95 [0.39-2.30]	0.9080	0.62 [0.20-1.91]	0.3991
Apgar 5-minutes <7 a	()	=== (=====)	0.00 [0.00 =.00]		0.00 [0.00 0.00]	1 0.000
No	193 (98.97)	1,430 (97.88)				
Yes	2 (1.03)	31 (2.12)				
Intubation	2 (1.03)	31 (2.12)				
No	159 (81.54)	1,230 (84.19)	1.00 [referent]		1.00 [referent]	
Yes	36 (18.46)	231 (15.81)	1.13 [0.49-2.58]	0.7789	1.68 [0.59-4.81]	0.3326
Early Preterm Birth	30 (10.40)	231 (13.01)	1.13 [0.73-2.30]	1 0.7703	1.00 [0.00-4.01]	0.3320
No No	155 (79.49)	1,255 (85.90)	1.00 [referent]		1.00 [referent]	
Yes	40 (20.51)	206 (14.10)	2.57 [0.75-8.80]	0.1333	0.79 [0.23-2.80]	0.7200
POBW <15 th Percentile	+0 (20.31)	200 (14.10)	2.37 [0.73-0.00]	0.1333	0.73 [0.23-2.00]	0.7200
No Percentile	142 (72.82)	1,089 (74.54)	1.00 [referent]		1.00 [referent]	
Yes	36 (18.46)	181 (12.39)	1.62 [0.72-3.66]	0.2464	1.74 [0.71-4.25]	0.2224
Unavailable			1.02 [0.72-3.00]	0.2404	1.74 [0.71-4.25]	0.2224
	17 (8.72)	191 (13.07)				
Parity	E4 /2C 4E)	C11 (11 02)	4.00 [4.00 [
0	51 (26.15)	611 (41.82)	1.00 [referent]	0.0006	1.00 [referent]	0.0000
1	81 (41.54)	502 (34.36)	4.67 [1.71-12.70]	0.0026	5.12 [1.25-20.99]	0.0232
≥2	63 (32.31)	348 (23.82)	6.18 [2.09-18.27]	0.0010	6.37 [1.00-40.66]	0.0504
Child						
Sex	05 (42 50)	765 (52.26)	100 [[1]		4.00 [[1]	
Female	85 (43.59)	765 (52.36)	1.00 [referent]	0.0007	1.00 [referent]	0.0044
Male	110 (56.41)	696 (47.64)	3.03 [1.60-5.71]	0.0007	3.57 [1.66-7.65]	0.0011
Ethnicity	165 (01.60)	1 107 (05 00)	1.000 0 11		1005 5 1	
Other	165 (84.62)	1,407 (96.30)	1.00 [referent]		1.00 [referent]	1
Indigenous Australian	30 (15.38)	54 (3.70)	34.27 [7.49-156.82]	<0.0001	2.22 [0.32-15.52]	0.4199
Child Speaks Language		1	1.001.0		1.001.0	
No	167 (85.64)	1,349 (92.33)	1.00 [referent]		1.00 [referent]	T a a :
Yes	28 (14.36)	112 (7.67)	3.82 [0.89-16.47]	0.0724	2.14 [0.49-9.35]	0.3127
Age Category at Time o	· · · · · · · · · · · · · · · · · · ·				T =	T -
1	48 (24.62)	273 (18.69)	2.09 [0.74-5.89]	0.1641	2.18 [0.77-6.16]	0.1401
2	128 (65.64)	1,071 (73.31)	1.00 [referent]		1.00 [referent]	1 .
3	19 (9.74)	117 (8.01)	2.56 [0.56-11.82]	0.2273	1.06 [0.22-5.19]	0.9434
Total Number of Sibling	<u> </u>		-		I -	
1	41 (21.03)	467 (31.96)	1.00 [referent]		1.00 [referent]	T
2	79 (40.51)	575 (39.36)	2.82 [1.01-7.88]	0.0478	0.63 [0.15-2.60]	0.5215
3	35 (17.95)	279 (19.10)	2.40 [0.71-8.13]	0.1600	0.23 [0.04-1.40]	0.1104
>3	40 (20.51)	140 (9.58)	17.34 [4.37-68.74]	<0.0001	2.14 [0.29-15.84]	0.4546
Sociodemographic						
Index of Relative Socio	economic Disadv	antage				
Lowest Quintile	141 (72.31)	1,232 (84.33)	6.87 [1.80-26.28]	0.0049	1.52 [0.47-4.94]	0.4863
> Lowest Quintile	46 (23.59)	191 (13.07)	1.00 [referent]		1.00 [referent]	
Unavailable	8 (4.10)	38 (2.60)				
- 1 1 1 2 · · ·						

^a Excluded from multivariable analysis due to small N.

^b Age categories classified as; ≥3 years 10 months to <5 years and one month, 2) ≥5 years and one month to <5 years and 10 months (reference category), 3) ≥5 years and 10 months to <6 years 10 months.

Table 5. Risk Factors for Developmental Vulnerability on the Communication Skills & General Knowledge Domain.

Knowledge Domain.						
	DV	NDV	Bivariate		Multivariable	
Characteristic	(N=200)	(N=1,456)		ì	(N=1,352)	
	N (%)	N (%)	OR [95% CI]	p-value	aOR [95% CI]	p-value
Maternal						
Age at Time of Child's B	irth (years)		_			
<25	59 (29.50)	163 (11.20)	13.25 [3.50-50.17]	0.0002	10.96 [2.24-53.75]	0.0032
25-29	40 (20.00)	344 (23.63)	1.00 [referent]		1.00 [referent]	
30-34	59 (29.50)	547 (37.57)	0.74 [0.24-2.28]	0.6016	1.17 [0.33-4.09]	0.8113
≥35	42 (21.00)	402 (27.61)	0.75 [0.23-2.47]	0.6322	1.34 [0.34-5.26]	0.6752
Marital Status				•	,	
Married (inc. de facto)	160 (80.00)	1,320 (90.66)	1.00 [referent]		1.00 [referent]	
All Other	40 (20.00)	130 (8.93)	14.40 [2.74-75.72]	0.0017	2.28 [0.52-10.04]	0.2762
Unavailable	0 (0.00)	6 (0.41)		'		•
Occupational Status Sca	le at Time of Ch					
0-20	68 (34.00)	241 (16.55)	11.20 [3.86-32.50]	<0.0001	2.11 [0.67-6.65]	0.2026
>20-100	117 (58.50)	1,168 (80.22)	1.00 [referent]	ı	1.00 [referent]	1
Unavailable	15 (7.50)	47 (3.23)				
Pregnancy & Birth	128 (7.188)	(8.23)				
Fertility Treatments		4				
No	188 (94.00)	1,200 (82.42)	1.00 [referent]		1.00 [referent]	
Yes	12 (6.00)	256 (17.58)	0.10 [0.02-0.39]	0.0009	0.32 [0.06-1.64]	0.1721
Smoking Status During I	. ,	250 (17.56)	0.10 [0.02-0.33]	0.0003	0.32 [0.00-1.04]	0.1721
No	148 (74.00)	1,270 (87.23)	1.00 [referent]		1.00 [referent]	
Yes	52 (26.00)	186 (12.77)		0.0002	1.51 [0.42-5.45]	0.5321
	32 (20.00)	100 (12.77)	7.79 [2.61-23.28]	0.0002	1.31 [0.42-3.43]	0.5521
Pre-eclampsia	475 (07 50)	4 205 (00 26)	4.00 [f		4.00 [
No	175 (87.50)	1,285 (88.26)	1.00 [referent]	0.0240	1.00 [referent]	0.0444
Yes	25 (12.50)	171 (11.74)	1.07 [0.29-3.90]	0.9240	0.95 [0.21-4.20]	0.9441
Gestational Diabetes	107 (00 50)	1.057 (00.00)	1.00 ()		1001 1	
No	187 (93.50)	1,367 (93.89)	1.00 [referent]	T	1.00 [referent]	T = ====
Yes	13 (6.50)	89 (6.11)	1.16 [0.20-6.72]	0.8696	1.39 [0.23-8.50]	0.7243
Threatened Abortion		T			T	
No	192 (96.00)	1,380 (94.78)	1.00 [referent]		1.00 [referent]	
Yes	8 (4.00)	76 (5.22)	0.55 [0.09-3.48]	0.5237	0.37 [0.02-5.73]	0.4767
Other Pregnancy Relate						
No	51 (25.50)	525 (36.06)	1.00 [referent]	T	1.00 [referent]	
Yes	149 (74.50)	931 (63.94)	2.53 [1.07-6.00]	0.0352	1.61 [0.53-4.90]	0.4040
Threatened Preterm Lai						
No	178 (89.00)	1,286 (88.32)	1.00 [referent]		1.00 [referent]	
Yes	22 (11.00)	170 (11.68)	1.00 [0.27-3.61]	0.9937	0.45 [0.11-1.88]	0.2716
APH						
No	188 (94.00)	1,410 (96.84)	1.00 [referent]		1.00 [referent]	
Yes	12 (6.00)	46 (3.16)	9.09 [0.70-117.63]	0.0910	1.15 [0.12-11.44]	0.9047
Placenta Praevia ^a						
No	200 (100.00)	1,446 (99.31)				
Yes	0 (0.00)	10 (0.69)				
Placental Abruption a				•		•
No	199 (99.50)	1,451 (99.66)				
Yes	1 (0.50)	5 (0.34)				
Fetal Distress	,	. , ,				1
No	172 (86.00)	1,346 (92.45)	1.00 [referent]		1.00 [referent]	
Yes	28 (14.00)	110 (7.55)	4.73 [1.00-22.38]	0.0503	2.21 [0.52-9.41]	0.2853
Cephalopelvic Dispropo	_ ' '	(,,,,,,,		1 2.2000	[2.02 0.12]	1 2.2000
No	200 (100.00)	1,452 (99.73)				
Yes	0 (0.00)	4 (0.27)				
Prolapsed Cord ^a	0 (0.00)	-T (U.27)				
No	200 (100)	1,443 (99.11)				
INU	200 (100)	1,443 (33.11)				

Yes	0 (0.00)	13 (0.89)				
Precipitate Delivery ^a						
No	195 (97.50)	1,435 (98.56)				
Yes	5 (2.50)	21 (1.44)				
PPH ≥500mls						
No	122 (61.00)	1,077 (73.97)	1.00 [referent]		1.00 [referent]	
Yes	78 (39.00)	379 (26.03)	3.72 [1.41-9.86]	0.0082	2.38 [0.84-6.74]	0.1040
TSR ≥2mins				•		•
No	163 (81.50)	1,261 (86.61)	1.00 [referent]		1.00 [referent]	
Yes	37 (18.50)	195 (13.39)	2.80 [1.08-7.22]	0.0335	1.55 [0.50-4.86]	0.4481
Apgar 5-minutes <7 a	, ,	, ,			· · · ·	
No	198 (99.00)	1,425 (97.87)				
Yes	2 (1.00)	31 (2.13)				
Intubation		_ (/				
No	162 (81.00)	1,227 (84.27)	1.00 [referent]		1.00 [referent]	
Yes	38 (19.00)	229 (15.73)	1.91 [0.80-4.56]	0.1467	1.32 [0.45-3.90]	0.6143
Early Preterm Birth	35 (25.55)	(1.02 [0.0000]	0.12.07	1.02 [0: 10 0.00]	1 0.02.0
No	157 (78.50)	1,253 (86.06)	1.00 [referent]		1.00 [referent]	
Yes	43 (21.50)	203 (13.94)	3.73 [0.99-14.09]	0.0527	1.68 [0.48-5.82]	0.4133
POBW <15 th Percentile	13 (21.30)	203 (13.3 1)	3.73 [0.33 1 1.03]	0.0327	1.00 [0.10 3.02]	1 011233
No	146 (73.00)	1,085 (74.52)	1.00 [referent]		1.00 [referent]	
Yes	36 (18.00)	181 (12.43)	1.83 [0.78-4.33]	0.1657	1.77 [0.72-4.32]	0.2113
Unavailable	18 (9.00)	190 (13.05)	1.03 [0.70 4.33]	0.1037	1.77 [0.72 4.32]	0.2113
Parity	10 (5.00)	150 (15.05)				
0	65 (32.50)	597 (41.00)	1.00 [referent]		1.00 [referent]	
1	68 (34.00)	515 (35.37)	1.51 [0.59-3.86]	0.3845	1.56 [0.38-6.42]	0.5363
≥2	67 (33.50)	344 (23.63)	4.54 [1.47-14.09]	0.0088	2.48 [0.38-15.95]	0.3303
Child	07 (33.30)	344 (23.03)	1.54 [1.47-14.05]	0.0000	2.40 [0.30-13.33]	0.5557
Sex						
Female	87 (43.50)	763 (52.40)	1.00 [referent]		1.00 [referent]	
Male	113 (56.50)	693 (47.60)	3.00 [1.56-5.79]	0.0011	3.26 [1.49-7.10]	0.0030
Ethnicity	113 (30.30)	093 (47.00)	3.00 [1.30-3.73]	0.0011	3.20 [1.43-7.10]	0.0030
Other	179 (89.50)	1,393 (95.67)	1.00 [referent]		1.00 [referent]	
	-			0.0068		0.0416
Indigenous Australian Child Speaks Language	21 (10.50)	63 (4.33)	21.66 [2.34-200.50]	0.0008	0.81 [0.10-6.68]	0.8416
		1,355 (93.06)	1.00 [referent]		1.00 [referent]	
No Yes	161 (80.50)	1	1.00 [referent] 11.16 [3.30-37.77]	0.0001	1.00 [referent] 17.83 [4.10-77.61]	0.0001
	39 (19.50)	101 (6.94)	11.10 [3.30-37.77]	0.0001	17.85 [4.10-77.61]	0.0001
Age Category at Time of			E 60 [1 72 19 00]	0.0041	6.01 [1.07.10.21]	0.0016
2	57 (28.5)	264 (18.13)	5.60 [1.73-18.09] 1.00 [referent]	0.0041	6.01 [1.97-18.31] 1.00 [referent]	0.0016
3	125 (62.5)	1,074 (73.76)	1.00 [referent]	0.3900		0.7610
	18 (9)	118 (8.1)	1.91 [0.44-8.30]	0.3869	1.30 [0.24-6.95]	0.7618
Total Number of Sibling	<u>, </u>	450 (24 52)	1 00 [nofo		1.00 [wafawa:=1]	
1	49 (24.50)	459 (31.52)	1.00 [referent]	0.2070	1.00 [referent]	0.0027
2	77 (38.50)	577 (39.63)	1.54 [0.58-4.13]	0.3870	0.88 [0.20-3.81]	0.8637
3	37 (18.50)	277 (19.02)	1.64 [0.49-5.44]	0.4189	1.11 [0.18-6.78]	0.9131
>3	37 (18.50)	143 (9.82)	15.85 [2.91-86.42]	0.0014	4.07 [0.48-34.47]	0.1976
Sociodemographic	:					
Index of Relative Socioe		1 -				
Lowest Quintile	153 (76.50)	1,220 (83.79)	4.24 [1.12-16.03]	0.0332	0.92 [0.26-3.26]	0.8903
> Lowest Quintile	42 (21.00)	195 (13.39)	1.00 [referent]		1.00 [referent]	
Unavailable a Excluded from multivari	5 (2.50)	41 (2.82)				
a byoluded from multiver	ionio analyzaia du	a to amoli N				

^a Excluded from multivariable analysis due to small N.

^b Age categories classified as; ≥3 years 10 months to <5 years and one month, 2) ≥5 years and one month to <5 years and 10 months (reference category), 3) ≥5 years and 10 months to <6 years 10 months.

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of cohort studies

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	3
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5-6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	3
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	3 and 7
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	7
		(b) For matched studies, give matching criteria and number of exposed and unexposed	n/a
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-10
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-10
Bias	9	Describe any efforts to address potential sources of bias	6-10
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7-10
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	10
		(b) Describe any methods used to examine subgroups and interactions	10
		(c) Explain how missing data were addressed	10
		(d) If applicable, explain how loss to follow-up was addressed	10
		(e) Describe any sensitivity analyses	10
Results			

		I	1
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed	7-11
		eligible, included in the study, completing follow-up, and analysed	
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential	10-11 and 26-29
		confounders	
		(b) Indicate number of participants with missing data for each variable of interest	26-31
		(c) Summarise follow-up time (eg, average and total amount)	N/A
Outcome data	15*	Report numbers of outcome events or summary measures over time	26-29
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence	10-11 and 26-29
		interval). Make clear which confounders were adjusted for and why they were included	
		(b) Report category boundaries when continuous variables were categorized	10-11
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	11
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from	4 and 14
		similar studies, and other relevant evidence	
Generalisability	21	Discuss the generalisability (external validity) of the study results	15
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on	17
		which the present article is based	

^{*}Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

The associations between biological and sociodemographic risks for developmental vulnerability in twins at age five: A population data linkage study in Western Australia.

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Manuscript ID	bmjopen-2020-038846.R2
Article Type:	Original research
Date Submitted by the Author:	15-Sep-2020
Complete List of Authors:	Dhamrait, Gursimran; Telethon Kids Institute, ; The University of Western Australia Faculty of Health and Medical Sciences, School of Population and Global Health Christensen, Daniel; Telethon Kids Institute Pereira, G.F; Telethon Kids Institute; Curtin University, School of Public Health Taylor, Catherine; Telethon Kids Institute; University of Western Australia,
Primary Subject Heading :	Paediatrics
Secondary Subject Heading:	Public health, Epidemiology
Keywords:	EPIDEMIOLOGY, PAEDIATRICS, PUBLIC HEALTH

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7	2	<u>Manuscript</u>
	3	Title: The associations between biological and sociodemographic risks for developmental
_	4	vulnerability in twins at age five: A population data linkage study in Western Australia.
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43 44 2	6	
45 2	7	Short Title: Developmental vulnerability in twins at age five
46 47 2		
48 49 2	9	Abbreviations
50 3 51	0	AEDC: Australian Early Development Census
52 3		ARIA: Accessibility and Remoteness Index of Australia
⁵³ ₅₄ 3	2	AUSEI06: Australian Socioeconomic Index 2006
⁵⁵ 3	3	DV1: Developmentally Vulnerable on one or more Australian Early Development Census domains
57 3	4	DV2: Developmentally Vulnerable on two or more Australian Early Development Census domains
58 59 3		CI: Confidence Interval
⁶⁰ 3	6	IRSD: Index of Relative Socioeconomic Disadvantage

37 MNS: Midwives Notifications System

3 38 OR: Odds Ratio

39 POBW: Proportion of Optimal Birth Weight

40 WA: Western Australia

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Keywords (max of 5):

Twins, Australian Early Development Census, Child Development, Record Linkage.



- 44 **Abstract** 45 Objective: To investigate the prevalence of, and associations between, prenatal and perinatal risk 46 factors and developmental vulnerability in twins at age five. Design: Retrospective cohort study using bivariate and multivariable logistic regression. 47 10 48 Setting: Western Australia (WA), 2002-2015. 12 49 Participants: 828 twin pairs born in WA with an Australian Early Development Census (AEDC) 14 15 50 record from 2009, 2012 or 2015. Main Outcome Measures: The AEDC is a national measure of child development across five domains. 17 51 19 52 Children with scores <10th percentile were classified as developmentally vulnerable on, one or more 21 22 53 domains (DV1), or two or more domains (DV2). 23 24 54 Results: In this population, 26.0% twins were classified as DV1 and 14.1% as DV2. In the 26 55 multivariable model, risk factors for DV1 were; maternal age <25 years (aOR 7.06, 95% CI 2.29-²⁸ 56 21.76), child speaking a language other than English at home (aOR 6.45, 95% CI 2.17-19.17), male 30 31 57 child (aOR 5.08, 95% CI: 2.89-8.92), age younger than the reference category for the study sample 33 58 (≥5 years one month to <5 years 10 months) at time of AEDC completion (aOR 3.34, 95% CI: 1.55-³⁵ 59 7.22), and having a proportion of optimal birthweight (POBW) <15th percentile of the study sample 38 60 (aOR 2.06, 95% CI 1.07-3.98). Risk factors for DV2 were; male child (aOR 7.87, 95% CI: 3.45-40 61 17.97), maternal age <25 years (aOR 5.60, 95% CI: 1.30-24.10), age younger than the reference 42 43 category (aOR 5.36, 95% CI: 1.94-14.82), child speaking a language other than English at home (aOR 45 63 4.65, 95% CI: 1.14-19.03), mother's marital status as not married at the time of twins' birth (aOR 4.59, 95% CI: 1.13-18.55), maternal occupation status in the lowest quintile (aOR 3.30, 95% CI: 1.11-47 64 9.81) and a POBW <15th percentile (aOR 3.11, 95% CI: 1.26-7.64).
 - Conclusion: Both biological and sociodemographic risk factors are associated with developmental

Article Summary

Strengths and Limitations

- The study is based on a large population-level sample of 1,656 twins.
- This is the first twin study to assess developmental vulnerabilities in an otherwise healthy sample of Australian twins, at the time of their first year of full-time school.
- Bivariate and multivariable logistic regression analysis with the calculation of adjusted odds ratios was performed to explore the associations between a large range of prenatal and perinatal risk factors.
- Twin pairs for which data was complete were used for the analysis.
- The datasets used in this study did not report on twin zygosity nor on complications of pregnancy that are specific to multiple pregnancies (e.g., twin reversed arterial perfusion, twintwin transfusion syndrome).

Introduction

The increased use of assisted reproductive technologies and increasing maternal age at conception have attributed to a significant increase in the number of multifetal pregnancies around the world.¹ Multifetal pregnancies are classified as high-risk pregnancies and compared to singleton pregnancies. are associated with higher rates of pregnancy complications and adverse neonatal and perinatal outcomes.²⁻⁶ The majority of the literature assessing higher-order pregnancies has focused primarily on birth outcomes, including preterm birth, low birthweight, and developmental disabilities such as cerebral palsy. 8 Studies that have assessed the longer-term developmental outcomes of twins have focused on developmental outcomes around the age of two years. 9 Such studies have reported that twins had poorer performance, in comparison to singletons, on a range of domains including; communication, gross and fine motor skills, problem solving, personal-social skills, and language development. 10,11 Furthermore, most studies examining child development outcomes at school starting age have focused on singleton children, from a single family and have compared children across families. 12 There is a paucity of research on the developmental vulnerability of multifetal pregnancies such as twins, around the time that they commence formal education. Child development outcomes can vary significantly based on numerous factors including the child's personal characteristics, such as personal dispositions and abilities, social constructs, and the environments, both intrauterine and extrauterine, in which they develop. 13-16 Studies that have assessed cognitive and school performance outcomes at the age of five have reported that children who are born preterm, ¹⁷⁻²⁴ with a low birthweight, ²⁵⁻²⁸ are small for gestational age, ^{29,30} and male³¹⁻³⁴ are more likely to have poorer developmental outcomes. In comparison to singletons, twins are more likely to be classified as preterm³⁵ or low birthweight, and have fetal growth restriction.³⁶ Studies have also reported that twins are more likely to have poorer neurodevelopmental outcomes compared to singletons, even after controlling for gestational age and birthweight.³⁷ A study reported that twins scored lower than singletons in both the Verbal and Performance IQ domains of the Wechsler Preschool and Primary Scale of Intelligence, at the ages of four and five years.³⁸ Likewise, twin studies have also reported sex differences, with girls scoring higher than boys at ages four and five

years.³⁸ The cumulative nature of school-based learning means that developmental gaps at school

42 43¹25 44 45| 26

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133 **Data Sources**

entry, are difficult to close over time.³⁹ Children who begin school with poor school readiness often struggle to catch up with their peers and tend to fall further behind as they progress through the subsequent years of schooling.³⁹ As educational achievement trajectories are largely established by 7 years of age (year 3) children with poor school readiness are more likely to have lower later-life educational achievement. 40 Given the higher rates of pregnancy, neonatal and perinatal adversities observed in twins in comparison to singletons, twins are particularly at risk for developmental delays in the early childhood period. Twin studies, assessing the contribution of genes and the environment, have supported the hypothesis that both factors impact child development. 41-44 Yet, a number of studies have reported no significant differences in child development outcomes based on zygosity. 38,45,46 Sociodemographic factors such as low socioeconomic status and low levels of parental education have also been identified to adversely impact child development outcomes.⁴⁷⁻⁴⁹ A study conducted in younger twins (assessed at age 6, 12, and 18 months) reported that biological factors including low birthweight were associated with poorer early cognitive and non-cognitive development, independently of environmental factors, such as socioeconomic status.³ Alternatively, a study reported that the environmental factors shared by twins of the same family were more significantly associated with early language skills and school readiness in twins at the age of five years, in comparison to genetic factors. 45 Overall, studies assessing both biological and sociodemographic factors, and their impact on the longer-term child development of children born from multiple pregnancies, remain sparse and the results of the existing studies are mixed. The aim of this study was to examine the prevalence of, and the association between, biological and sociodemographic risk factors and developmental vulnerability in twins in their first year of full-time school.

Methods

Data Sources and Study Population

This study used anonymised individual-level data from the Midwives Notification System (MNS), which is a statutory record of all births (still- or live-born) in WA with either a birthweight >400 grams and/or a final gestational length of ≥20 weeks. Variables from MNS were cross validated with corresponding records from WA Birth Registrations. Australian Early Development Census (AEDC) records were obtained for all available years (2009, 2012, and 2015) for all children with WA birth and perinatal records. Across the 2009, 2012, and 2015 AEDC data collections child participation for the State of WA ranged between 98.7-99.6%.⁵⁰ WA Register for Developmental Anomalies (WARDA) records were used to identify children who had a diagnosed developmental disability between birth and age five years. Statistical linkage of all records, by matching identifiers (e.g. name, address, date of birth, etc.) common to sets of records,⁵¹ was provided by the WA Data Linkage Branch from the Department of Health WA.

Patient and Public Involvement

No patients were involved in the development of the research question or the outcome measures, or in the development of the plans for the design or implementation of the study.

Study Population

The study population included all children born in WA with an AEDC record in either 2009, 2012 or 2015 (N=73,903). Children were excluded from the study if; 1) they were not from a twin birth (N=71,748), 2) they were identified by their teacher as having 'special-needs' based on a diagnosed physical and/or intellectual disability (N=123), 3) they were reported as having any birth defect in the WARDA datasets (N=119), 4) they had an AEDC score that was either incomplete or missing (N=22), or 5) their twin sibling was excluded based on the aforementioned exclusion criteria (N=235; Figure 1). The final study sample consisted of N=1,656 children; N=828 twin pairs. There were 252 opposite sex twin pairs and 576 same sex twin pairs (277 male and 299 female twin pairs).

Outcome Measure

The AEDC is a national census of early childhood development spanning five developmental domains; 1) Physical Health and Wellbeing, 2) Social Competence, 3) Emotional Maturity, 4)

Language and Cognitive Skills (school-based), and 5) Communication Skills and General Knowledge.

The AEDC is conducted every three years, with the first national data collection conducted in 2009. Children with scores <10th percentile in a given domain are classified as 'developmentally vulnerable' (DV). For this study children who scored >10th percentile for a given domain were classified as 'not developmentally vulnerable' (NDV). AEDC cut-off scores are based on the first national AEDC data collection in 2009 and apply to all AEDC data collections. Domain scores for children with special needs are not included in the AEDC results. In this study, two summarised outcome measures were used; developmentally vulnerable on one or more AEDC domains (DV1) and developmentally vulnerable on two or more AEDC domains (DV2).

Risk Variables

Maternal Variables

Maternal age and marital status at twins' birth were obtained from the MNS and Birth Registrations. Maternal occupation at birth was obtained from Birth Registrations data and converted to a four-digit standard code using the Australian and New Zealand Standard Classification of Occupations. These codes were then assigned a value ranging from 0-100 using the Australian Socioeconomic Index 2006 (AUSEI06).⁵² Low AUSEI06 values are representative of low-status occupations and high values represent high-status occupations. This variable was collapsed into two categories; the most disadvantaged quintile (i.e. AUSEI06 [0-20]) and greater than the most disadvantaged quintile (i.e. AUSEI06 >20). An AUSEI06 value of zero was assigned to records if maternal occupation was reported as 'unemployed,' 'stay at home parent,' or 'pensioner.' For records where maternal occupation was not stated, an AUSEI06 value was not assigned and these cases were reported as missing.

Pregnancy and Birth Variables

We included several binary pregnancy and birth variables to indicate either the presence or absence; of fertility treatments, smoking during pregnancy, pre-eclampsia, gestational diabetes, threatened abortion, threatened preterm labour, antepartum haemorrhage (APH), placenta praevia, placental abruption, fetal distress, cephalopelvic disproportion, prolapsed cord, precipitate delivery, post-partum haemorrhage (PPH), intubation status, early preterm birth (<34 weeks of gestational age), and time to

Spontaneous Respiration (TSR); with a TSR of ≥2 minutes forming the 'at risk' group, and five-minute Apgar score; with a five-minute Apgar score of <7 forming the 'at risk' group.

The proportion of optimal birthweight (POBW) is a measure of fetal growth and is defined as birthweight divided by expected birthweight in the absence of pathologic risk factors. This measure also accounts for non-pathologic determinants of growth, including gestational age, birth order, sex of the child, and maternal height, ⁵³ and has been validated against ultrasound measurements. ⁵⁴ We derived a binary proxy for fetal growth restriction as POBW <15th percentile, which corresponded to an observed birthweight less than 75.75% of that expected. ⁹

We derived a general category for other pregnancy-related complications (not elsewhere stated; such as urinary tract infection, pre-labour rupture of membranes) for all records. As records may have multiple pregnancy-related complications, all records that had a complication that was not elsewhere stated in this study or had multiple complications of which at least one complication was not elsewhere stated in this study, formed the 'at risk' group for this variable.

Child Variables

Sex and ethnicity of the child were obtained from the MNS and Birth Registrations. Age at the time of AEDC completion and language other than English spoken at home by the child were obtained from the AEDC. Age of children at the time of AEDC completion ranged between; ≥ 3 years 10 months to < 6 years 10 months, with a mean of age category of, ≥ 5 years one month to 5 years 10 months. To balance frequencies, the age of children at the time of AEDC completion was categorised into three groups; 1) ≥ 3 years 10 months to < 5 years and one month, 2) ≥ 5 years one month to < 5 years 10 months (reference category) and 3) ≥ 5 years 10 months to < 6 years 10 months.

The total number of siblings was derived as the number of live births to each mother prior to the year that the cohort child had the AEDC conducted. Siblings who died within the neonatal period (i.e. mode of separation post-birth from the hospital was death) were excluded in the calculations for the total number of siblings.

Sociodemographic Variables

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The Index of Relative Socioeconomic Disadvantage (IRSD)¹⁹ was calculated using the residential address at the time of birth. ISRD is derived from Australian Census data and reflects area-level disadvantage through variables such as low household income, low educational attainment, and high levels of unemployment. This variable was collapsed into two groups; most disadvantaged quintile (i.e. ISRD quintile 1) and greater than the most disadvantaged quintile (i.e. ISRD quintiles 2-5).

Statistical Modelling

For each risk variable, the 'least risk' category (e.g. not early preterm birth) was used as the reference category (Table 1). To estimate the risk of a child being classified as DV1 and DV2, a generalised linear mixed model with a logit link function was used with a random intercept for each twin pair. A total of 30 maternal, pregnancy, birth, child, and sociodemographic risk variables were considered for the multivariable models. For DV1, DV2, and each of the five AEDC domains, 24 risk variables were included in the multivariable models; six risk variables were excluded from multivariable analysis due to the prevalence being too small (total N<50 for a given category of a given variable). The variables excluded were; 1) placenta praevia, 2) placental abruption, 3) cephalopelvic disproportion, 4) prolapsed cord, 5) precipitate delivery and 6) a five-minute Apgar score of <7. All variables were added simultaneously to the models. Odds ratios (OR) and the associated 95% confidence intervals (CIs) were estimated for both unadjusted and adjusted models. All analyses were undertaken using PROC GLIMMIX in SAS version 9.4 for Windows.⁵⁵

Results

Prevalence of developmental vulnerability in twins

A total of 431 (26.0%) twins were classified as DV1 (Table 1). A total of 151 (18.2%) twin pairs had one twin identified as DV1 and 140 (16.9%) twin pairs had both twins were identified as DV1. Of the 24 maternal, pregnancy and birth, child, and sociodemographic risk variables considered in the multivariable models, five variables had a statistically significant association with an increased risk of a twin being classified as DV1. In order of decreasing magnitude of associated risk, the ORs were; maternal age of <25 younger at time of twins' birth (aOR 7.06, 95% CI 2.29 to 21.76), child speaks a language other than English at home (aOR 6.45, 95% CI 2.17 to 19.17), male twins (aOR 5.08, 95%

 $\frac{1}{2}241$

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CI 2.89 to 8.92), child's age younger than the reference category for the study sample (≥5 years one month to 5 years 7 months) at the time of AEDC completion (aOR 3.34, 95% CI: 1.55 to 7.22), and POBW <15th percentile (aOR 2.06, 95% CI 1.07 to 3.98). There was a statistically significant association between an increased risk of a twin being classified as DV1 and maternal age at the time of twins' birth (p=0.003), age category at time of ADEC completion (p=0.006), and the total number of sibling (p=0.0248).

A total of 223 (14.1%) twins were classified as DV2 (Table 2). In 95 (11.5%) twin pairs, one twin was

identified as DV2 and in 64 twin pairs (7.9%), both twins were identified as DV2. Of the 24 maternal, pregnancy and birth, child, and sociodemographic risk variables considered in the adjusted models, seven variables had a statistically significant association with an increased risk of a twin being classified as DV2. Risk factors for DV2 were, in order of decreasing magnitude; male twins (aOR 7.87, 95% CI: 3.45 to 17.97), maternal age of <25 younger at time of twins' birth (aOR 5.60, 95% CI: 1.30 to 24.10), child's age younger than the reference category at time of AEDC completion (aOR 5.36, 95% CI: 1.94 to 14.82), child speaking a language other than English at home (aOR 4.65, 95% CI: 1.14 to 19.03), mother's marital status as not married at the time of twins' birth (aOR 4.59, 95% CI: 1.13 to 18.55), maternal occupation status in the lowest quintile (aOR 3.30, 95% CI: 1.11 to 9.81) and POBW <15th percentile (aOR 3.11, 95% CI: 1.26 to 7.64). There was a statistically significant association between an increased risk of a twin being classified as DV2 and the age category at the time of ADEC completion (p=0.001).

Associations with domain-specific developmental vulnerability

A total of, 188 (11.4%) children were classified as developmentally vulnerable (DV) for the domains of; Physical Health and Wellbeing, 151 (9.1%) for Social Competence, 147 (8.9%) for Emotional Maturity, 195 (11.8%) for Language and Cognitive Skills (school-based), and 200 (12.0%) for Communication Skills and General Knowledge (Supplementary Tables 1-5, respectively). These results were broadly consistent with the findings for the aggregate measures of developmental vulnerability (DV1 and DV2). All variables that were statistically significant in the aggregated measures of developmental vulnerability were statistically significant for the domains.

Discussion

This study examined the associations between biological and sociodemographic risk factors and developmental vulnerability in twins in their first year of full-time school. To our knowledge, our study is the first of this scale (population-level sample of twins; N>1,600) to report on the prevalence of developmental vulnerabilities, in an otherwise healthy sample of twins, at the time of their first year of full-time school. As studies have reported that twins are more likely to have poorer performance, in comparison to singletons, at the age of two^{10,11} it was pertinent to assess if the prevalence rates of developmental vulnerabilities are higher in twins at age five. We reported that in the WA population, 26.0% of twins were classified as DV1 and 14.1% as DV2 across the 2009, 2012, and 2015 AEDC cycles. In the general WA population, which includes twins and higher-order multiples, 23.0% of children were classified as DV1 and 11.3% of children were classified as DV2, across these AEDC cycles.⁵⁰ A large cohort study of 99,530 singleton children from New South Wales reported that 20.8% were classified as DV1 across the 2009 and 2012 AEDC cycles. 56 Thus, we found that twins are at an elevated risk of developmental vulnerability relative to a general population of children in the state of Western Australia and in a singleton population in New South Wales. This is consistent with findings from a study of 142 twin pairs from the Louisville Twin Study, that reported twins scored lower than singletons in both the Verbal and Performance IQ domains of the Wechsler Preschool and Primary Scale of Intelligence at both four and five years of age.³⁸ As our results were obtained from a sample of twins without any diagnosed developmental disabilities, the higher prevalence rates of twins being classified as DV1 and DV2 observed in our study, when compared to the general Australian population, suggests that healthy twins are more likely to be classified as developmentally vulnerable on AEDC domains at school starting age when compared to their singleton counterparts. The biological factors associated with developmental vulnerability in twins were; male sex, fetal growth restriction, and younger chronological age at the time of AEDC completion. These results are in line with singleton studies^{31,57} which have reported that male children are more likely to be classified as developmentally vulnerable in their first year of full-time school, in comparison to female children. A study conducted in South Australia of 13,827 children, of which 3.4% were twins, also

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reported that male twins were more likely to be classified as DV2 when compared to female twins, however, this finding was not statistically significant.⁵⁸ The Louisville Twin Study also reported sex differences, with females scoring higher on Full Scale, Verbal, and Performance IQ, than males at ages four and five years, however, scores tended to converge at six years of age.³⁸ We also reported that twins younger than the reference category for this sample were more likely to be classified as developmentally vulnerable in their first year of full-time school. A study of 840 Canadian five-year-old twins, aiming to assess the genetic and environmental factors influencing school readiness, reported that in the preliminary models age was positively correlated with the spatial recognition, numbers, and letters components of the Lollipop test.⁵⁹ Furthermore, a recent discussion paper identified the need for further research to assess the effects of delaying school entry for twins⁶⁰ thus, highlighting that further research is required to better understand if delaying school entry is beneficial for both short-term and long-term academic outcomes in twins. The sociodemographic risk factors associated with developmental vulnerability in twins included; maternal age, maternal occupational status, and a not married maternal marital status, at the time of twins' birth, and the child speaking a language other than English at home. These results are supported by the South Australian study, which examined a range of variables also included in our study. 58 This study reported that maternal age, marital status, and maternal occupation were associated with an increased risk of children being classified as DV2 on the AEDC.⁵⁸ The South Australian study also reported that parity and smoking during pregnancy were also associated with an increased risk of children being classified as DV2.58 In our study, we observed an increased but statistically insignificant association between these risk variables and twins being classified as either DV1 or DV2. An interesting finding from our study was that speaking a language other than English at home was associated with an increased risk for twins being classified as DV1 and DV2. Previous studies have reported that approximately a fifth of Australian children are bilingual, 61 and the prevalence of twins

speaking a language other than English at home in our study were in line with these results. Results

from an Australia-wide study of 261,147 children (including singletons and multiples) from the 2009 AEDC cycle, reported that bilingual children proficient in English have an equal or slightly lower odds of being classed as DV1 when compared to their English-speaking background peers. 61 However, unlike our study, this study⁶¹ did not report differences in developmental vulnerability based on plurality. Additionally, a Canadian study examining the school readiness profiles of 95,537 children in British Columbia⁶² reported that bilingualism was associated with positive social, emotional, and cognitive development, as measured by the Early Development Index.³⁴ Differences in results may be attributed to the fact bilingualism may be a risk factor for twins, however, it may not be a significant risk factor in a general population sample. The language groups most commonly spoken in WA after English (Mandarin, Italian and Vietnamese)⁶³ are different to those most prevalent in British Colombia (Punjabi, Chinese and German).⁶⁴ Thus, the difference in findings between the Canadian study and our results may be attributable to this fact. Our findings have some accord with a cohort study examining the associations between biological and sociodemographic risk factors on late language emergence in 473 twins pairs at the age of two years.⁹ Taylor et al. reported that the risk factors for late language emergence in twins, without developmental disabilities, include fetal growth restriction. Interestingly, our study also identified fetal growth restriction as a risk factor for developmental vulnerability at age five, suggesting that the biological implications of a suboptimal intrauterine environment may persist beyond infancy and into early childhood in twins not diagnosed developmental disabilities. In contrast to our study, the Taylor et al. twin sample excluded twins with exposure to languages other than English. This study reported that sociodemographic risk factors (low maternal education, socioeconomic area disadvantage) were not associated with late language emergence at age two years. Our results suggest that sociodemographic factors including, maternal; age, marital status and occupational status, at time of twins' birth, and the child speaking a language other than English at home are associated with an increased risk of developmental vulnerability at age five. 9 The differences in findings between this study and our study suggest that sociodemographic characteristics may play a more significant role as risk variables at age five years compared to at the age of two years. This hypothesis is supported by a subsequent study of

twins aged four and six years, which reported that higher maternal education and older maternal age showed positive effects on language and non-verbal phenotypes.⁶ Furthermore, a study of a twin sample from the Quebec Newborn Twin Study reported that environmental factors, such as socioeconomic status, rather than genetic factors were attributable to the predictive association observed between early language skills and school readiness, as measured by the Lollipop Test, in twins 63-months of age. 45 In our study, the zygosity of twins could not be established as WA administrative data does not contain information on zygosity. Furthermore, we did not aim to assess the impact of within twin-pair discordance in regards to developmental vulnerabilities at age five. Thus, further research is required to better elucidate the impact and interplay of biological and sociodemographic risk variables at different stages of development in twins. Studies assessing twin-singleton differences often control for or select for factors such as prematurity, low birthweight, or parental socioeconomic status. 57,65,66 Our study, however, draws attention to the adverse effects of other risk factors, including POBW and maternal marital status, on child development outcomes at age five. An Australian cohort study of 1,922 children from the Northern Territory using linked administrative data, reported an increased, but non-statistically significant, risk of twins being classified as DV1 on the AEDC, after controlling for a range of biological and sociodemographic variables used in our study including; sex, 5-minute Apgar score <7, area remoteness, ethnicity, child speaks a language other than English at home and maternal age at the time of the child's birth.⁵⁷ Although this study gave consideration to plurality as a risk factor for developmental vulnerability, it did not aim to assess the association between a comprehensive set of biological and sociodemographic risk factors. A Canadian study of 5-year old twins reported that shared environmental factors substantially accounted for cognitive school readiness (as measured by the Lollipop Test) as compared to genetic effects.⁵⁹ Likewise, other studies have also reported that a range of family factors, which would be assumed to be shared by both twins, such as family income, maternal occupation, and employment status are associated with cognitive school readiness. 67,68 Further studies in this area are required, as the extent and nature of the risk factors associated with developmental vulnerability at age five in twins remain not well-established.

Preventative intervention studies have reported that programs designed to improve school readiness and high-quality early childhood education and care, are effective for at-risk populations and can have significant long-term results.^{69,70} The higher prevalence rates of DV1 and DV2 in twins observed in this study are indicative of the fact that twins form an at-risk group in terms of developmental vulnerability at the time at which children commence full-time school. Therefore, it is pertinent for those working in the early childhood education sector and for parents to be aware of the developmental vulnerabilities present in twins at the age at which children begin full-time school. In Australia, there has been a call to provide increased quantity and quality of support service and resources for twins and their families due to increased vulnerability,⁶⁰ and the results of our study highlight this need.

Conclusions

Both biological and sociodemographic risk factors are associated with developmental vulnerability at the age of five in twins. The findings of our study suggest that twins are more likely to be classified as developmentally vulnerable at school starting age when compared to their singleton counterparts. In particular, the results draw attention to the hypothesis that prenatal, and more significantly perinatal, risk factors and the sociodemographic environments in which twins are raised can impact developmental vulnerability in early childhood.

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Department or the Australian Government.

Ethics Approval:

Acknowledgements:

Ethics approval for this study was granted by the Western Australian Department of Health Human Research Ethics Committee (2016/51) and the University of Western Australia Human Research Ethics Committee (RA/4/20/4776).

Declaration of interests:

The authors declare that they have no competing interests, no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

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Author Contributions:

GKD: led study conceptualisation and design, conducted the literature review, performed data manipulation, analysis and interpretation of findings, drafted the initial manuscript and reviewed and revised the manuscript critically for important intellectual content.

DC, GP and CLT: contributed to the study inception, the development of the design, interpretation of the results, manuscript revisions, the interpretation of the results and revised the manuscript critically for important intellectual content.

GKD, DC, GP and CLT: approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

Data Sharing:

The linked administrative data are owned by the government departments who approved the linkage and use of the data for this study. Use of the study data is restricted to named researchers. The current Human Research Ethics Committee approvals were obtained for public sharing and presentation of data on group level only, meaning the data used in this study cannot be shared by the authors. Collaborative research may be conducted according to the ethical requirements and relevant privacy legislations. Potential collaborators should contact author GP with their expression of interest. The steps involved in seeking permission for linkage and use of the data used in this study are the same for all researchers.

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Figures & Tables: (Total 1 Figure & 2 Tables)

Figure 1. Eligible Cohort and Numbers Included for Analyses.
AEDC = Australian Early Development Census. WARDA= Western Australian Register of Developmental Anomalies.

Table 1. Risk factors for children who are developmentally vulnerable on one or more AEDC domains (DV1).

(DV1).						
	DV1	NDV1	Bivariate		Multivariable	
Characteristic	(N=431)	(N=1,225)			(N=1,352)	i
	N (%)	N (%)	OR [95% CI]	p-value	aOR [95% CI]	p-value
Maternal						
Age at Time of Child's E				1	1	ı
<25	105 (24.36)	117 (9.55)	9.66 [3.68-25.32]	<0.001	7.06 [2.29-21.76]	<0.001
25-29	90 (20.88)	294 (24.00)	1 [referent]	1	1 [referent]	1
30-34	130 (30.16)	476 (38.86)	0.81 [0.38-1.72]	0.576	0.89 [0.38-2.07]	0.780
≥35	106 (24.59)	338 (27.59)	1.06 [0.48-2.36]	0.886	1.19 [0.47-2.99]	0.715
			Overall p-value	<0.001	Overall p-value	0.003
Marital Status	T		Г		T	
Married (inc. de facto)	357 (82.83)	1,123 (91.67)	1 [referent]	1	1 [referent]	I
All Other	72 (16.71)	98 (8.00)	5.99 [2.43-14.75]	<0.001	2.26 [0.76-6.71]	0.140
Unavailable	2 (0.46)	4 (0.33)				
Occupational Status Sca				I	T	
0-20	122 (28.31)	187 (15.27)	5.58 [2.71-11.46]	<0.001	1.83 [0.79-4.26]	0.159
>20-100	279 (64.73)	1,006 (82.12)	1 [referent]		1 [referent]	
Unavailable	30 (6.96)	32 (2.61)				
Pregnancy & Birth						
Fertility Treatments		1 2 (22 - 22)			1.5.6	
No	377 (87.47)	1,011 (82.53)	1 [referent]		1 [referent]	
Yes	54 (12.53)	214 (17.47)	0.43 [0.19-0.97]	0.042	0.84 [0.32-2.23]	0.729
Smoking Status During		4 070 (00 00)	4.5. 6		4.5.6	
No	339 (78.65)	1,079 (88.08)	1 [referent]		1 [referent]	0 ==0
Yes	92 (21.35)	146 (11.92)	4.31 [1.95-9.53]	<0.001	0.87 [0.34-2.27]	0.779
Pre-eclampsia						
No	375 (87.01)	1,085 (88.57)	1 [referent]		1 [referent]	0.00
Yes	56 (12.99)	140 (11.43)	1.40 [0.59-3.34]	0.444	1.82 [0.68-4.88]	0.237
Gestational Diabetes	402 (02 27)	4.452.(04.04)	4 [4 [
No	402 (93.27)	1,152 (94.04)	1 [referent]	0.657	1 [referent]	0.026
Yes	29 (6.73)	73 (5.96)	1.30 [0.40-4.22]	0.657	1.15 [0.33-4.09]	0.826
Threatened Abortion	416 (06 52)	1 156 (04 27)	1 [unfavoual]		1 [45f54541]	
No	416 (96.52)	1,156 (94.37)	1 [referent]	0.151	1 [referent]	0.102
Yes	15 (3.48)	69 (5.63)	0.36 [0.09-1.45]	0.151	0.23 [0.04-1.35]	0.103
Other Pregnancy Relate			1 [referent]		1 [referent]	
No Yes	125 (29.00) 306 (71.00)	451 (36.82) 774 (63.18)	1 [referent] 2.08 [1.12-3.85]	0.020	1.79 [0.85-3.79]	0.129
Threatened Preterm La		774 (05.16)	2.06 [1.12-3.65]	0.020	1.79 [0.85-3.79]	0.129
No	376 (87.24)	1,088 (88.82)	1 [referent]		1 [referent]	
Yes	55 (12.76)	137 (11.18)	1.34 [0.55-3.24]	0.519	0.68 [0.25-1.83]	0.446
APH	33 (12.70)	13/ (11.10)	1.34 [0.33-3.24]	0.515	0.00 [0.23-1.03]	0.440
No	411 (95.36)	1,187 (96.90)	1 [referent]		1 [referent]	
Yes	20 (4.64)	38 (3.10)	2.38 [0.53-10.73]	0.260	0.67 [0.12-3.85]	0.650
Placenta Praevia ^a	20 (4.04)	38 (3.10)	2.30 [0.33-10.73]	0.200	0.07 [0.12-3.83]	0.030
No No	429 (99.54)	1,217 (99.35)				
Yes	2 (0.46)	8 (0.65)				
Placental Abruption ^a	2 (0.40)	0 (0.03)				
No No	427 (99.07)	1,223 (99.84)				
Yes	4 (0.93)	2 (0.16)				
Fetal Distress	1 (0.55)	_ (0.10)				
No No	382 (88.63)	1,136 (92.73)	1 [referent]		1 [referent]	
Yes	49 (11.37)	89 (7.27)	2.92 [1.13-7.58]	0.028	1.76 [0.60-5.13]	0.301
Cephalopelvic Dispropo	· · · · ·	05 (1.21)	[2.15 7.50]	1 3.323	1.70 [0.00 3.13]	0.501
No	431 (100.00)	1,221 (99.67)				
Yes	0 (0.00)	4 (0.33)				
	J (0.00)	1 (0.55)				

5 L L0 L3						
Prolapsed Cord ^a		T		1	I	I
No	428 (99.30)	1,215 (99.18)				
Yes	3 (0.70)	10 (0.82)				
Precipitate Delivery ^a						
No	424 (98.38)	1,206 (98.45)				
Yes	7 (1.62)	19 (1.55)				
PPH ≥500mls	•					
No	281 (65.20)	918 (74.94)	1 [referent]		1 [referent]	
Yes	150 (34.80)	307 (25.06)	2.59 [1.39-4.82]	0.003	1.52 [0.73-3.16]	0.260
TSR ≥2mins	100 (000)	(20.00)		0.000	1.02 [0.70 0.10]	0.200
No	364 (84.45)	1,060 (86.53)	1 [referent]		1 [referent]	
Yes	67 (15.55)	165 (13.47)	1.06 [0.56-1.99]	0.863	0.52 [0.22-1.21]	0.128
Apgar 5-minutes <7 °	07 (13.33)	103 (13.47)	1.00 [0.50-1.55]	0.003	0.32 [0.22-1.21]	0.120
	425 (00 61)	1 100 (07 00)				
No	425 (98.61)	1,198 (97.80)				
Yes	6 (1.39)	27 (2.20)				
Intubation						
No	353 (81.90)	1,036 (84.57)	1 [referent]	I	1 [referent]	I
Yes	78 (18.10)	189 (15.43)	1.36 [0.75-2.45]	0.313	1.54 [0.71-3.37]	0.277
Early Preterm Birth					T	
No	352 (81.67)	1,058 (86.37)	1 [referent]		1 [referent]	
Yes	79 (18.33)	167 (13.63)	2.08 [0.94-4.56]	0.069	1.29 [0.53-3.15]	0.579
POBW <15 th Percentile						
No	305 (70.77)	926 (75.59)	1 [referent]		1 [referent]	
Yes	81 (18.79)	136 (11.10)	2.09 [1.14-3.84]	0.017	2.06 [1.07-3.98]	0.031
Unavailable	45 (10.44)	163 (13.31)				
Parity	,					
0	150 (34.80)	512 (41.80)	1 [referent]		1 [referent]	
1	154 (35.73)	429 (35.02)	1.62 [0.83-3.16]	0.158	1.96 [0.77-5.00]	0.159
≥2	127 (29.47)	284 (23.18)	2.50 [1.20-5.22]	0.015	2.03 [0.55-7.48]	0.288
22	127 (23.47)	204 (23.10)	Overall p-value	0.048	Overall p-value	0.351
Child			Overall p-value	0.048	Overall p-value	0.551
Sex						
	176 (40 04)	(74 /55 02)	1 [4-6-4-4]		1 [45f54541]	
Female	176 (40.84)	674 (55.02)	1 [referent]	.0.004	1 [referent]	.0.004
Male	255 (59.16)	551 (44.98)	4.44 [2.68-7.36]	<0.001	5.08 [2.89-8.92]	<0.001
Ethnicity		T			T	
Other	385 (89.33)	1,187 (96.90)	1 [referent]		1 [referent]	1
Indigenous Australian	46 (10.67)	38 (3.10)	16.98 [4.85-59.46]	<0.001	2.46 [0.46-13.03]	0.291
Child Speaks Language	Other Than Eng	<u> </u>			1	
No	367 (85.15)	1,149 (93.80)	1 [referent]		1 [referent]	
Yes	64 (14.85)	76 (6.20)	6.28 [2.48-15.90]	<0.001	6.45 [2.17-19.17]	<0.001
Age Category at Time o	f AEDC Comple	tion ^b				
1	109 (25.29)	212 (17.31)	2.93 [1.45-5.90]	0.003	3.34 [1.55-7.22]	0.002
2	288 (66.82)	911 (74.37)	1 [referent]		1 [referent]	
3	34 (7.89)	102 (8.33)	1.18 [0.43-3.27]	0.746	0.77 [0.23-2.54]	0.666
			Overall p-value	0.011	Overall p-value	0.006
Total Number of Sibling	ξS					
1	119 (27.61)	389 (31.76)	1 [referent]		1 [referent]	
2	160 (37.12)	494 (40.33)	1.15 [0.58-2.30]	0.685	0.70 [0.27-1.83]	0.461
3	74 (17.17)	240 (19.59)	1.04 [0.45-2.41]	0.926	0.44 [0.13-1.55]	0.120
>3	78 (18.10)	102 (8.33)	7.28 [2.73-19.45]	<0.001	2.71 [0.60-12.22]	0.120
· J	/ 0 (10.10)	102 (0.33)	Overall p-value	<0.001	Overall p-value	0.194
Sociodemographic			Overall p-value		Overall p-value	0.025
Index of Relative Socio	oconomic Dis-	lyantaga				
			2 55 [4 62 7 70]	0.003	1 62 [0 66 4 02]	0.207
Lowest Quintile	327 (75.87)	1,046 (85.39)	3.55 [1.62-7.78]	0.002	1.63 [0.66-4.02]	0.287
> Lowest Quintile	87 (20.19)	150 (12.24)	1 [referent]		1 [referent]	
Unavailable 3 Excluded from multivar	17 (3.94)	29 (2.37)				
Liraliaded trems mailtaries	andia amalazara d	TIO to Green II N				

^a Excluded from multivariable analysis due to small N.

^b Age categories classified as; 1) ≥3 years 10 months to <5 years and one month, 2) ≥5 years and one month to <5 years and 10 months (reference category), 3) ≥5 years and 10 months to <6 years 10 months.

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Table 2. Risk factors for children who are developmentally vulnerable on two or more AEDC domains (DV2).

domains (DV2).						
	DV2	NDV2	Bivariate		Multivariable	
Characteristic	(N=223)	(N=1,433)		ì	(N=1,352)	ī
	N (%)	N (%)	OR [95% CI]	p-value	aOR [95% CI]	p-value
Maternal						
Age at Time of Child's E	irth (years)				1	
<25	63 (28.25)	159 (11.10)	7.81 [2.60-23.45]	<0.001	5.60 [1.30-24.10]	0.021
25-29	48 (21.52)	336 (23.45)	1 [referent]		1 [referent]	
30-34	64 (28.70)	542 (37.82)	0.65 [0.26-1.63]	0.356	0.92 [0.29-2.91]	0.885
≥35	48 (21.52)	396 (27.63)	0.67 [0.25-1.81]	0.434	0.77 [0.22-2.76]	0.689
			Overall p-value	<0.001	Overall p-value	0.072
Marital Status						
Married (inc. de facto)	172 (77.13)	1,308 (91.28)	1 [referent]		1 [referent]	
All Other	49 (21.97)	121 (8.44)	9.91 [3.54-27.77]	<0.001	4.59 [1.13-18.55]	0.033
Unavailable	2 (0.90)	4 (0.28)				
Occupational Status Sca	ale at Time of C	hild's Birth				
0-20	78 (34.98)	231 (16.12)	8.82 [3.72-20.89]	<0.001	3.30 [1.11-9.81]	0.032
>20-100	130 (58.30)	1,155 (80.60)	1 [referent]		1 [referent]	
Unavailable	15 (6.73)	47 (3.28)				
Pregnancy & Birth						
Fertility Treatments						
No	200 (89.69)	1,188 (82.90)	1 [referent]		1 [referent]	
Yes	23 (10.31)	245 (17.10)	0.35 [0.13-0.97]	0.042	0.67 [0.17-2.69]	0.567
Smoking Status During	Pregnancy					
No	166 (74.44)	1,252 (87.37)	1 [referent]		1 [referent]	
Yes	57 (25.56)	181 (12.63)	5.83 [2.32-14.65]	<0.001	1.27 [0.38-4.30]	0.700
Pre-eclampsia						
No	195 (87.44)	1,265 (88.28)	1 [referent]		1 [referent]	
Yes	28 (12.56)	168 (11.72)	1.25 [0.41-3.86]	0.693	2.45 [0.65-9.17]	0.184
Gestational Diabetes						
No	208 (93.27)	1,346 (93.93)	1 [referent]		1 [referent]	
Yes	15 (6.73)	87 (6.07)	1.44 [0.32-6.42]	0.635	2.29 [0.46-11.44]	0.312
Threatened Abortion				•		
No	214 (95.96)	1,358 (94.77)	1 [referent]		1 [referent]	
Yes	9 (4.04)	75 (5.23)	0.54 [0.10-2.94]	0.478	0.24 [0.02-3.08]	0.274
Other Pregnancy Relate	ed Complication	าร				
No	57 (25.56)	519 (36.22)	1 [referent]		1 [referent]	
Yes	166 (74.44)	914 (63.78)	2.64 [1.22-5.69]	0.014	1.64 [0.58-4.61]	0.351
Threatened Preterm La	bour					
No	191 (85.65)	1,273 (88.83)	1 [referent]		1 [referent]	
Yes	32 (14.35)	160 (11.17)	2.04 [0.66-6.29]	0.216	0.72 [0.20-2.61]	0.613
APH						
No	209 (93.72)	1,389 (96.93)	1 [referent]		1 [referent]	
Yes	14 (6.28)	44 (3.07)	5.96 [0.95-37.40]	0.057	1.45 [0.36-5.87]	0.599
Placenta Praevia ^a						
No	223 (100.00)	1,423 (99.30)				
Yes	0 (0.00)	10 (0.70)				
Placental Abruption a	,			•		
No	221 (99.10)	1,429 (99.72)				
Yes	2 (0.90)	4 (0.28)				
Fetal Distress	. , ,	, ,				
No	195 (87.44)	1,323 (92.32)	1 [referent]		1 [referent]	
Yes	28 (12.56)	110 (7.68)	3.03 [0.90-10.23]	0.074	1.56 [0.59-4.15]	0.368
Cephalopelvic Dispropo		. ()	1 [3.55 20.20]	1	[
No	223 (100.00)	1,429 (99.72)				
Yes	0 (0.00)	4 (0.28)				
	0 (0.00)	. (0.20)				

Prolapsed Cord ^a						
No	220 (98.65)	1,423 (99.30)				
Yes	3 (1.35)	10 (0.70)				
Precipitate Delivery a						
No	219 (98.21)	1,411 (98.46)				
Yes	4 (1.79)	22 (1.54)				
PPH ≥500mls						
No	141 (63.23)	1,058 (73.83)	1 [referent]		1 [referent]	
Yes	82 (36.77)	375 (26.17)	3.43 [1.49-7.94]	0.004	1.38 [0.16-11.79]	0.766
TSR ≥2mins						
No	183 (82.06)	1,241 (86.60)	1 [referent]		1 [referent]	
Yes	40 (17.94)	192 (13.40)	1.78 [0.81-3.89]	0.149	0.91 [0.30-2.72]	0.863
Apgar 5-minutes <7 a				•		
No	219 (98.21)	1,404 (97.98)				
Yes	4 (1.79)	29 (2.02)				
Intubation						
No	178 (79.82)	1,211 (84.51)	1 [referent]		1 [referent]	
Yes	45 (20.18)	222 (15.49)	1.91 [0.90-4.05]	0.093	1.53 [0.54-4.35]	0.429
Early Preterm Birth		, ,				
No	172 (77.13)	1,238 (86.39)	1 [referent]		1 [referent]	
Yes	51 (22.87)	195 (13.61)	4.18 [1.50-11.67]	0.006	2.06 [0.64-6.58]	0.224
POBW <15 th Percentile						
No	162 (72.65)	1,069 (74.60)	1 [referent]		1 [referent]	
Yes	42 (18.83)	175 (12.21)	2.72 [1.25-5.93]	0.012	3.11 [1.26-7.64]	0.014
Unavailable	19 (8.52)	189 (13.19)				
Parity	== (===)	1 200 (2012)				
0	79 (35.43)	583 (40.68)	1 [referent]		1 [referent]	
1	73 (32.74)	510 (35.59)	1.18 [0.51-2.76]	0.700	1.12 [0.31-4.04]	0.861
<u>-</u> ≥2	71 (31.84)	340 (23.73)	2.66 [1.04-6.83]	0.042	3.61 [0.61-21.22]	0.155
	1 = (0 = 10 1)		Overall p-value	0.109	Overall p-value	0.283
Child			Total praide	0.1203	Trending Tunde	0.200
Sex						
Female	83 (37.22)	767 (53.52)	1 [referent]		1 [referent]	
Male	140 (62.78)	666 (46.48)	5.42 [2.79-10.55]	<0.001	7.87 [3.45-17.97]	<0.001
Ethnicity	110 (02.70)	000 (10.10)	5112 [2175 20150]	10.002	7.07 [0.10 17.57]	10.002
Other	197 (88.34)	1,375 (95.95)	1 [referent]		1 [referent]	
Indigenous Australian	26 (11.66)	58 (4.05)	11.00 [2.78-43.60]	<0.001	2.32 [0.32-16.84]	0.404
Child Speaks Language				.5.001	52 [0.52 10.64]	5.404
No	192 (86.10)	1,324 (92.39)	1 [referent]		1 [referent]	
Yes	31 (13.90)	109 (7.61)	3.19 [0.96-10.63]	0.059	4.65 [1.14-19.03]	0.033
Age Category at Time o			1 [3.55 25.65]	1.000	[2	
1	66 (29.60)	255 (17.79)	4.11 [1.80-9.39]	<0.001	5.36 [1.94-14.82]	0.001
2	142 (63.68)	1,057 (73.76)	1 [referent]	10.002	1 [referent]	0.001
3	15 (6.73)	121 (8.44)	0.95 [0.26-3.46]	0.942	0.28 [0.05-1.70]	0.167
-		(0.17)	Overall p-value	0.003	Overall p-value	0.001
Total Number of Sibling	2S		1 Stellan p value	1.000		
1	58 (26.01)	450 (31.40)	1 [referent]		1 [referent]	
2	84 (37.67)	570 (39.78)	1.35 [0.57-3.19]	0.489	1.26 [0.34-4.71]	0.733
3	38 (17.04)	276 (19.26)	1.14 [0.40-3.24]	0.403	0.47 [0.08-2.70]	0.395
>3	43 (19.28)	137 (9.56)	7.14 [2.24-22.72]	<0.001	2.52 [0.34-18.73]	0.366
- 5	13 (13.20)	13, (3.30)	Overall p-value	0.006	Overall p-value	0.175
Sociodemographic			Overall p-value	0.000	Overall p-value	0.1/3
Index of Relative Socio	economic Disa	lvantage				
Lowest Quintile	175 (78.48)	1,198 (83.60)	2.14 [0.76-6.02]	0.151	0.68 [0.21-2.25]	0.529
> Lowest Quintile	39 (17.49)	198 (13.82)	1 [referent]	0.131	1 [referent]	0.323
Unavailable	9 (4.04)	37 (2.58)	T [TETETETIL]		T [LEIGIGIII]	
Evoluded from multivar	<u> </u>					

^a Excluded from multivariable analysis due to small N.

^b Age categories classified as; 1) ≥3 years 10 months to <5 years and one month, 2) ≥5 years and one month to <5 years and 10 months (reference category), 3) ≥5 years and 10 months to <6 years 10 months.

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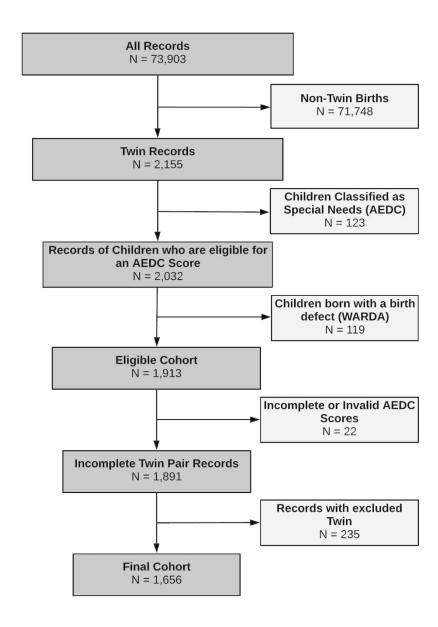


Figure 1. Eligible Cohort and Numbers Included for Analyses.AEDC = Australian Early Development Census. WARDA= Western Australian Register of Developmental Anomalies.

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Supplementary Tables

Table 1. Risk Factors for Developmental Vulnerability on the Physical Health & Wellbeing Domain.

Table 1. KISK Factors	1			ai i icaiui		iaiii.
a	DV	NDV	Bivariate		Multivariable	
Characteristic	(N=188)	(N=1,468)	0.5 (0.5)	1 .	(N=1,352)	1 .
	N (%)	N (%)	OR [95% CI]	p-value	aOR [95% CI]	p-value
Maternal						
Age at Time of Child's B		1	1		1	1
<25	46 (24.47)	176 (11.99)	5.36 [1.64-17.48]	0.002	3.59 [0.93-13.90]	0.065
25-29	39 (20.74)	345 (23.50)	1 [referent]	_	1 [referent]	_
30-34	62 (32.98)	544 (37.06)	1.08 [0.41-2.87]	0.646	1.13 [0.39-3.25]	0.821
≥35	41 (21.81)	403 (27.45)	0.83 [0.29-2.38]	0.776	0.97 [0.30-3.13]	0.959
			Overall p-value	0.009	Overall p-value	0.269
Marital Status						
Married (inc. de facto)	152 (80.85)	1,328 (90.46)	1 [referent]		1 [referent]	
All Other	36 (19.15)	134 (9.13)	5.54 [1.87-16.35]	0.002	2.39 [0.66-8.70]	0.185
Unavailable	0 (0.00)	6 (0.41)				
Occupational Status Sca						
0-20	52 (27.66)	257 (17.51)	3.29 [1.40-7.75]	0.025	0.79 [0.28-2.27]	0.663
>20-100	119 (63.30)	1,166 (79.43)	1 [referent]		1 [referent]	1 0.000
Unavailable	17 (9.04)	45 (3.07)			_ [
Pregnancy & Birth		.5 (5.57)				
Fertility Treatments						
No	163 (86.70)	1,225 (83.45)	1 [referent]		1 [referent]	
	· · · · · · · · · · · · · · · · · · ·			0.359		0.014
Yes	25 (13.30)	243 (16.55)	0.61 [0.21-1.75]	0.359	1.07 [0.32-3.62]	0.914
Smoking Status During I		4 204 (07 47)	4.5. 6. 13		4.5. 6. 13	
No	134 (71.28)	1,284 (87.47)	1 [referent]	T	1 [referent]	T
Yes	54 (28.72)	184 (12.53)	7.19 [2.76-18.70]	<0.001	2.49 [0.83-7.51]	0.105
Pre-eclampsia	1				1	
No	163 (86.70)	1,297 (88.35)	1 [referent]		1 [referent]	1
Yes	25 (13.30)	171 (11.65)	1.56 [0.46-5.24]	0.475	2.99 [0.90-9.91]	0.074
Gestational Diabetes		T			1	
No	173 (92.02)	1,381 (94.07)	1 [referent]	_	1 [referent]	_
Yes	15 (7.98)	87 (5.93)	1.87 [0.36-9.87]	0.460	2.26 [0.50-10.20]	0.290
Threatened Abortion						
No	182 (96.81)	1,390 (94.69)	1 [referent]		1 [referent]	
Yes	6 (3.19)	78 (5.31)	0.45 [0.07-2.71]	0.379	0.43 [0.05-3.77]	0.443
Other Pregnancy Relate	d Complications	5				
No	51 (27.13)	525 (35.76)	1 [referent]	_	1 [referent]	
Yes	137 (72.87)	943 (64.24)	1.96 [0.87-4.42]	0.103	1.69 [0.65-4.42]	0.284
Threatened Preterm Lal	· · · · · · · · · · · · · · · · · · ·					
No	161 (85.64)	1,303 (88.76)	1 [referent]		1 [referent]	
Yes	27 (14.36)	165 (11.24)	1.68 [0.49-5.81]	0.411	0.86 [0.26-2.82]	0.797
APH	_ =: \	\ '/			3.00 [0.20 2.02]	1 0.707
No	178 (94.68)	1,420 (96.73)	1 [referent]		1 [referent]	
Yes	10 (5.32)	48 (3.27)	3.27 [0.37-28.63]	0.285	0.73 [0.09-5.96]	0.766
Placenta Praevia a	10 (3.32)	TO (J.27)	3.27 [0.37-20.03]	0.203	0.73 [0.03-3.30]	0.700
	197 (00 47)	1 450 (00 20)				
No	187 (99.47)	1,459 (99.39)				
Yes	1 (0.53)	9 (0.61)				
Placental Abruption a	405 (00 40)	4.465.400.00				
No	185 (98.40)	1,465 (99.8)				
Yes	3 (1.60)	3 (0.20)				
Fetal Distress	1	T	T		T	
No	162 (86.17)	1,356 (92.37)	1 [referent]	1	1 [referent]	
Yes	26 (13.83)	112 (7.63)	4.89 [1.20-19.90]	0.027	2.57 [0.72-9.19]	0.145
Cephalopelvic Dispropo		T				
No	188 (100.00)	1,464 (99.73)				
Yes	0 (0.00)	4 (0.27)				
Prolapsed Cord a						

No	188 (100.00)	1,455 (99.11)				
Yes	0 (0.00)	13 (0.89)				
Precipitate Delivery a		•				
No	186 (98.94)	1,444 (98.37)				
Yes	2 (1.06)	24 (1.63)				
PPH ≥500mls		•				
No	124 (65.96)	1,075 (73.23)	1 [referent]		1 [referent]	
Yes	64 (34.04)	393 (26.77)	2.16 [0.90-5.18]	0.084	0.90 [0.36-2.25]	0.826
TSR ≥2mins		•				
No	152 (80.85)	1,272 (86.65)	1 [referent]		1 [referent]	
Yes	36 (19.15)	196 (13.35)	1.48 [0.64-3.44]	0.363	0.55 [0.19-1.55]	0.258
Apgar 5-minutes <7 a				•		•
No	182 (96.81)	1,441 (98.16)				
Yes	6 (3.19)	27 (1.84)				
Intubation				•		•
No	147 (78.19)	1,242 (84.60)	1 [referent]		1 [referent]	
Yes	41 (21.81)	226 (15.40)	2.33 [1.03-5.28]	0.043	1.96 [0.75-5.10]	0.167
Early Preterm Birth						
No	146 (77.66)	1,264 (86.1)	1 [referent]		1 [referent]	
Yes	42 (22.34)	204 (13.9)	3.76 [1.21-11.68]	0.022	2.15 [0.76-6.11]	0.151
POBW <15 th Percentil	e			•		•
No	125 (66.49)	1,106 (75.34)	1 [referent]		1 [referent]	
Yes	42 (22.34)	175 (11.92)	3.44 [1.53-7.74]	0.003	2.58 [1.15-5.77]	0.022
Unavailable	21 (11.17)	187 (12.74)				
Parity						
0	67 (35.64)	595 (40.53)	1 [referent]		1 [referent]	
1	65 (34.57)	518 (35.29)	1.18 [0.48-2.86]	0.721	1.29 [0.41-4.08]	0.665
≥2	56 (29.79)	355 (24.18)	1.81 [0.67-4.91]	0.244	1.53 [0.29-8.17]	0.617
			Overall p-value	0.503	Overall p-value	0.866
Child						
Sex						
Female	82 (43.62)	768 (52.32)	1 [referent]		1 [referent]	
Male	106 (56.38)	700 (47.68)	2.50 [1.36-4.61]	0.003	3.31 [1.64-6.69]	<0.001
Ethnicity	·					
Other	167 (88.83)	1,405 (95.71)	1 [referent]		1 [referent]	
Indigenous Australian	21 (11.17)	63 (4.29)	12.56 [2.12-74.52]	0.005	0.80 [0.12-5.40]	0.816
Child Speaks Languag	e Other Than Eng	lish at Home				
No	159 (84.57)	1,357 (92.44)	1 [referent]	_	1 [referent]	
Yes	29 (15.43)	111 (7.56)	4.62 [1.24-17.26]	0.023	4.84 [1.34-17.48]	0.016
Age Category at Time	of AEDC Complet	ion	1			
1	50 (26.60)	271 (18.46)	2.76 [1.02-7.46]	<0.001	2.22 [0.88-5.60]	0.092
2	129 (68.62)	1,070 (72.89)	1 [referent]		1 [referent]	
3	9 (4.79)	127 (8.65)	0.44 [0.10-1.93]	0.942	0.19 [0.03-1.18]	0.074
			Overall p-value	0.049	Overall p-value	0.033
Total Number of Sibli	ngs					
1	51 (27.13)	457 (31.13)	1 [referent]		1 [referent]	
2	69 (36.70)	585 (39.85)	1.10 [0.46-2.63]	0.827	0.98 [0.30-3.15]	0.970
3	24 (12.77)	290 (19.75)	0.51 [0.16-1.57]	0.239	0.41 [0.08-2.10]	0.284
>3	44 (23.40)	136 (9.26)	8.32 [2.57-26.96]	<0.001	6.47 [0.98-42.75]	0.053
		•	Overall p-value	<0.001	Overall p-value	0.008
Sociodemographic						
Index of Relative Soci	oeconomic Disad	vantage				
Lowest Quintile	138 (73.40)	1,235 (84.13)	3.78 [1.17-12.22]	0.026	1.85 [0.63-5.44]	0.264
> Lowest Quintile	40 (21.28)	197 (13.42)	1 [referent]		1 [referent]	•
Unavailable	10 (5.32)	36 (2.45)				

a Excluded from multivariable analysis due to small N.

b Age categories classified as; 1) ≥3 years 10 months to <5 years and one month, 2) ≥5 years and one month to <5 years and 10 months (reference category), 3) ≥5 years and 10 months to <6 years 10 months.

Table 2. Risk Factors for Developmental Vulnerability on the Social Competence Domain.

Table 2. Risk Factors				ı Compet		
Characteristic	DV (N=151)	NDV	Bivariate		Multivariable	
Characteristic	(N=151) N (%)	(N=1,505) N (%)	OR [95% CI]	p-value	(N=1,352) aOR [95% CI]	p-value
Maternal	IN (70)	IN (70)	OK [93% CI]	p-value		p-value
Age at Time of Child's B	irth (vears)					
<25	43 (28.48)	179 (11.89)	6.32 [1.91-20.95]	0.003	3.13 [0.74-13.30]	0.122
25-29	31 (20.53)	353 (23.46)	1 [referent]	0.003	1 [referent]	0.122
30-34	44 (29.14)	562 (37.34)	0.78 [0.29-2.15]	0.634	1.36 [0.43-4.36]	0.604
≥35	33 (21.85)	411 (27.31)	0.81 [0.27-2.37]	0.696	0.99 [0.27-3.59]	0.982
	33 (21.03)	111 (27.31)	Overall p-value	0.002	Overall p-value	0.431
Marital Status			Overall p value	0.002	Overall p value	0.101
Married (inc. de facto)	113 (74.83)	1,367 (90.83)	1 [referent]		1 [referent]	
All Other	36 (23.84)	134 (8.90)	9.65 [3.20-29.05]	<0.001	10.16 [2.56-40.41]	0.001
Unavailable	2 (1.32)	4 (0.27)	one (one end)	101002		1 0.002
Occupational Status Sca						
0-20	50 (33.11)	259 (17.21)	5.05 [2.07-12.29]	<0.001	1.93 [0.64-5.79]	0.241
>20-100	94 (62.25)	1,191 (79.14)	1 [referent]	10.002	1 [referent]	0.2.12
Unavailable	7 (4.64)	55 (3.65)	2 [. 0. 0. 0. 0]		_ [. c. c. c. c. c]	
Pregnancy & Birth	1 (113.)	100 (0:00)				
Fertility Treatments						
No	132 (87.42)	1,256 (83.46)	1 [referent]		1 [referent]	
Yes	19 (12.58)	249 (16.54)	0.54 [0.18-1.60]	0.269	1.38 [0.37-5.17]	0.635
Smoking Status During I		10 (20:0 :)	0.0 . [0.20 2.00]	0.200	1.00 [0.07 0.17]	0.000
No	116 (76.82)	1,302 (86.51)	1 [referent]		1 [referent]	
Yes	35 (23.18)	203 (13.49)	3.70 [1.06-12.91]	0.041	1.22 [0.35-4.20]	0.753
Pre-eclampsia	100 (20:20)	1 === (===,=,				1 0.700
No	134 (88.74)	1,326 (88.11)	1 [referent]		1 [referent]	
Yes	17 (11.26)	179 (11.89)	0.98 [0.31-3.14]	0.975	1.84 [0.49-6.84]	0.365
Gestational Diabetes		170 (11.00)	0.00 [0.01 0.1.1]	0.070		0.000
No	140 (92.72)	1,414 (93.95)	1 [referent]		1 [referent]	
Yes	11 (7.28)	91 (6.05)	1.46 [0.32-6.60]	0.627	2.11 [0.41-10.74]	0.369
Threatened Abortion	(: :==)	1 - (0.00)		,		1
No	144 (95.36)	1,428 (94.88)	1 [referent]		1 [referent]	
Yes	7 (4.64)	77 (5.12)	0.66 [0.11-4.10]	0.658	0.13 [0.01-2.43]	0.171
Other Pregnancy Relate				1		
No	38 (25.17)	538 (35.75)	1 [referent]		1 [referent]	
Yes	113 (74.83)	967 (64.25)	2.15 [0.89-5.19]	0.088	2.00 [0.70-5.74]	0.196
Threatened Preterm Lak		(0.1127)				1 0.200
No	131 (86.75)	1,333 (88.57)	1 [referent]		1 [referent]	
Yes	20 (13.25)	172 (11.43)	1.32 [0.42-4.17]	0.640	0.69 [0.19-2.59]	0.584
APH		, ,==: .0,	1 - [1 [2:20]	1
No	142 (94.04)	1,456 (96.74)	1 [referent]		1 [referent]	
Yes	9 (5.96)	49 (3.26)	3.74 [0.62-22.66]	0.151	2.12 [0.27-16.50]	0.473
Placenta Praevia a	1 ()	- (/				1
No	151 (100.00)	1,495 (99.34)				
Yes	0 (0.00)	10 (0.66)				
Placental Abruption a	, , ,	, , ,				
No	149 (98.68)	1,501 (99.73)				
Yes	2 (1.32)	4 (0.27)				
Fetal Distress	. , ,	. , ,				•
No	132 (87.42)	1,386 (92.09)	1 [referent]		1 [referent]	
Yes	19 (12.58)	119 (7.91)	2.77 [0.81-9.50]	0.105	1.39 [0.33-5.82]	0.656
Cephalopelvic Dispropo		- (/	[[2:22 3:00]		1 [2:00]	1
No No	151 (100.00)	1,501 (99.73)				
Yes	0 (0.00)	4 (0.27)				
Prolapsed Cord a	1 3 (0.00)	1 (0.2.)				
No No	148 (98.01)	1,495 (99.34)				
	_ = := (5 5.51)					

	T					
Yes	3 (1.99)	10 (0.66)				
Precipitate Delivery a		1				•
No	149 (98.68)	1,481 (98.41)				
Yes	2 (1.32)	24 (1.59)				
PPH ≥500mls						
No	96 (63.58)	1,103 (73.29)	1 [referent]		1 [referent]	
Yes	55 (36.42)	402 (26.71)	2.61 [1.14-5.97]	0.023	1.42 [0.54-3.76]	0.477
TSR ≥2mins						
No	119 (78.81)	1,305 (86.71)	1 [referent]		1 [referent]	
Yes	32 (21.19)	200 (13.29)	1.76 [0.80-3.89]	0.161	0.80 [0.26-2.46]	0.697
Apgar 5-minutes <7 a	, ,	,			, ,	
No	147 (97.35)	1,476 (98.07)				
Yes	4 (2.65)	29 (1.93)				
Intubation	(=:==)	(,				
No	112 (74.17)	1,277 (84.85)	1 [referent]		1 [referent]	
Yes	39 (25.83)	228 (15.15)	2.31 [1.00-5.33]	0.051	2.48 [0.86-7.20]	0.093
Early Preterm Birth	(20.00)	(,		0.002	2. 10 [0.00 7.20]	0.033
No	123 (81.46)	1,287 (85.51)	1 [referent]		1 [referent]	
Yes	28 (18.54)	218 (14.49)	1.64 [0.59-4.57]	0.345	0.68 [0.20-2.27]	0.525
POBW <15 th Percentile	20 (10.54)	210 (14.43)	1.04 [0.55 4.57]	0.545	0.00 [0.20 2.27]	0.525
No No	114 (75.5)	1,117 (74.22)	1 [referent]		1 [referent]	
Yes	23 (15.23)	194 (12.89)	1.51 [0.65-3.54]	0.341	1.65 [0.63-4.30]	0.304
Unavailable	14 (9.27)	194 (12.89)	1.51 [0.05-5.54]	0.541	1.03 [0.03-4.30]	0.304
Parity	14 (3.27)	194 (12.89)				
-	EQ (20 41)	604 (40.13)	1 [referent]		1 [referent]	
0	58 (38.41) 49 (32.45)	534 (35.48)	1.06 [0.44-2.56]	0.906		0.027
	· · · · · · · · · · · · · · · · · · ·		•	0.906	0.87 [0.25-3.08] 2.02 [0.35-11.63]	0.827
≥2	44 (29.14)	367 (24.39)	1.73 [0.67-4.50]	1 0.259	1 2.02 10.35-11.031	0.432
	, ,	. ,				
	, ,		Overall p-value	0.481	Overall p-value	0.554
Child						
Child Sex			Overall p-value		Overall p-value	
Child Sex Female	51 (33.77)	799 (53.09)	Overall p-value 1 [referent]	0.481	Overall p-value 1 [referent]	0.554
Child Sex Female Male			Overall p-value		Overall p-value	
Child Sex Female Male Ethnicity	51 (33.77)	799 (53.09) 706 (46.91)	Overall p-value 1 [referent] 5.21 [2.58-10.52]	0.481	Overall p-value 1 [referent] 5.35 [2.38-12.00]	0.554
Child Sex Female Male Ethnicity Other	51 (33.77) 100 (66.23) 137 (90.73)	799 (53.09) 706 (46.91) 1,435 (95.35)	1 [referent] 5.21 [2.58-10.52]	0.481 <0.001	1 [referent] 5.35 [2.38-12.00]	0.554 <0.001
Child Sex Female Male Ethnicity Other Indigenous Australian	51 (33.77) 100 (66.23) 137 (90.73) 14 (9.27)	799 (53.09) 706 (46.91) 1,435 (95.35) 70 (4.65)	Overall p-value 1 [referent] 5.21 [2.58-10.52]	0.481	Overall p-value 1 [referent] 5.35 [2.38-12.00]	0.554
Child Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language (51 (33.77) 100 (66.23) 137 (90.73) 14 (9.27) Other Than Engl	799 (53.09) 706 (46.91) 1,435 (95.35) 70 (4.65) ish at Home	Overall p-value 1 [referent] 5.21 [2.58-10.52] 1 [referent] 3.96 [0.86-18.29]	0.481 <0.001	Overall p-value 1 [referent] 5.35 [2.38-12.00] 1 [referent] 2.43 [0.36-16.63]	0.554 <0.001
Child Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language (No	51 (33.77) 100 (66.23) 137 (90.73) 14 (9.27) Other Than Engl 139 (92.05)	799 (53.09) 706 (46.91) 1,435 (95.35) 70 (4.65) ish at Home 1,377 (91.50)	1 [referent] 5.21 [2.58-10.52] 1 [referent] 3.96 [0.86-18.29]	<0.001 0.078	1 [referent] 5.35 [2.38-12.00] 1 [referent] 2.43 [0.36-16.63]	<0.001 0.364
Child Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language (No Yes	51 (33.77) 100 (66.23) 137 (90.73) 14 (9.27) Other Than Engl 139 (92.05) 12 (7.95)	799 (53.09) 706 (46.91) 1,435 (95.35) 70 (4.65) ish at Home 1,377 (91.50) 128 (8.50)	Overall p-value 1 [referent] 5.21 [2.58-10.52] 1 [referent] 3.96 [0.86-18.29]	0.481 <0.001	Overall p-value 1 [referent] 5.35 [2.38-12.00] 1 [referent] 2.43 [0.36-16.63]	0.554 <0.001
Child Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language (No	51 (33.77) 100 (66.23) 137 (90.73) 14 (9.27) Other Than Engl 139 (92.05) 12 (7.95) F AEDC Complet	799 (53.09) 706 (46.91) 1,435 (95.35) 70 (4.65) ish at Home 1,377 (91.50) 128 (8.50) ion ^b	Overall p-value 1 [referent] 5.21 [2.58-10.52] 1 [referent] 3.96 [0.86-18.29] 1 [referent] 0.67 [0.17-2.62]	0.481 <0.001 0.078	Overall p-value 1 [referent] 5.35 [2.38-12.00] 1 [referent] 2.43 [0.36-16.63] 1 [referent] 1.13 [0.24-5.18]	<0.001 <0.364 0.880
Child Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language (No Yes Age Category at Time of	51 (33.77) 100 (66.23) 137 (90.73) 14 (9.27) Other Than Engl 139 (92.05) 12 (7.95) FAEDC Complet 40 (26.49)	799 (53.09) 706 (46.91) 1,435 (95.35) 70 (4.65) ish at Home 1,377 (91.50) 128 (8.50) ion ^b 281 (18.67)	1 [referent] 5.21 [2.58-10.52] 1 [referent] 3.96 [0.86-18.29] 1 [referent] 0.67 [0.17-2.62] 2.42 [0.98-5.94]	<0.001 0.078	1 [referent] 5.35 [2.38-12.00] 1 [referent] 2.43 [0.36-16.63] 1 [referent] 1.13 [0.24-5.18] 2.84 [1.05-7.73]	<0.001 0.364
Child Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language (No Yes Age Category at Time of 1 2	51 (33.77) 100 (66.23) 137 (90.73) 14 (9.27) Other Than Engl 139 (92.05) 12 (7.95) FAEDC Complet 40 (26.49) 98 (64.9)	799 (53.09) 706 (46.91) 1,435 (95.35) 70 (4.65) ish at Home 1,377 (91.50) 128 (8.50) ion b 281 (18.67) 1,101 (73.16)	1 [referent] 5.21 [2.58-10.52] 1 [referent] 3.96 [0.86-18.29] 1 [referent] 0.67 [0.17-2.62] 2.42 [0.98-5.94] 1 [referent]	0.481 <0.001 0.078 0.567	1 [referent] 5.35 [2.38-12.00] 1 [referent] 2.43 [0.36-16.63] 1 [referent] 1.13 [0.24-5.18] 2.84 [1.05-7.73] 1 [referent]	0.554 <0.001 0.364 0.880
Child Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language (No Yes Age Category at Time of	51 (33.77) 100 (66.23) 137 (90.73) 14 (9.27) Other Than Engl 139 (92.05) 12 (7.95) FAEDC Complet 40 (26.49)	799 (53.09) 706 (46.91) 1,435 (95.35) 70 (4.65) ish at Home 1,377 (91.50) 128 (8.50) ion ^b 281 (18.67)	1 [referent] 5.21 [2.58-10.52] 1 [referent] 3.96 [0.86-18.29] 1 [referent] 0.67 [0.17-2.62] 2.42 [0.98-5.94] 1 [referent] 1.73 [0.46-6.48]	0.481 <0.001 0.078	1 [referent] 5.35 [2.38-12.00] 1 [referent] 2.43 [0.36-16.63] 1 [referent] 1.13 [0.24-5.18] 2.84 [1.05-7.73]	0.554 <0.001 0.364 0.880 0.041
Child Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language (No Yes Age Category at Time of 1 2 3	51 (33.77) 100 (66.23) 137 (90.73) 14 (9.27) Other Than Engl 139 (92.05) 12 (7.95) FAEDC Complet 40 (26.49) 98 (64.9) 13 (8.61)	799 (53.09) 706 (46.91) 1,435 (95.35) 70 (4.65) ish at Home 1,377 (91.50) 128 (8.50) ion b 281 (18.67) 1,101 (73.16)	1 [referent] 5.21 [2.58-10.52] 1 [referent] 3.96 [0.86-18.29] 1 [referent] 0.67 [0.17-2.62] 2.42 [0.98-5.94] 1 [referent]	0.481 <0.001 0.078 0.567	1 [referent] 5.35 [2.38-12.00] 1 [referent] 2.43 [0.36-16.63] 1 [referent] 1.13 [0.24-5.18] 2.84 [1.05-7.73] 1 [referent]	0.554 <0.001 0.364 0.880
Child Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language (No Yes Age Category at Time of 1 2	51 (33.77) 100 (66.23) 137 (90.73) 14 (9.27) Other Than Engl 139 (92.05) 12 (7.95) F AEDC Complet 40 (26.49) 98 (64.9) 13 (8.61)	799 (53.09) 706 (46.91) 1,435 (95.35) 70 (4.65) ish at Home 1,377 (91.50) 128 (8.50) ion b 281 (18.67) 1,101 (73.16) 123 (8.17)	1 [referent] 5.21 [2.58-10.52] 1 [referent] 3.96 [0.86-18.29] 1 [referent] 0.67 [0.17-2.62] 2.42 [0.98-5.94] 1 [referent] 1.73 [0.46-6.48] Overall p-value	0.481 <0.001 0.078 0.567 0.055	1 [referent] 5.35 [2.38-12.00] 1 [referent] 2.43 [0.36-16.63] 1 [referent] 1.13 [0.24-5.18] 2.84 [1.05-7.73] 1 [referent] 0.51 [0.09-2.75] Overall p-value	0.554 <0.001 0.364 0.880 0.041
Child Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language (No Yes Age Category at Time of 1 2 3 Total Number of Sibling	51 (33.77) 100 (66.23) 137 (90.73) 14 (9.27) Other Than Engl 139 (92.05) 12 (7.95) FAEDC Complet 40 (26.49) 98 (64.9) 13 (8.61) s 41 (27.15)	799 (53.09) 706 (46.91) 1,435 (95.35) 70 (4.65) ish at Home 1,377 (91.50) 128 (8.50) ion b 281 (18.67) 1,101 (73.16) 123 (8.17) 467 (31.03)	1 [referent] 5.21 [2.58-10.52] 1 [referent] 3.96 [0.86-18.29] 1 [referent] 0.67 [0.17-2.62] 2.42 [0.98-5.94] 1 [referent] 1.73 [0.46-6.48] Overall p-value 1 [referent]	0.481 <0.001 0.078 0.567 0.055 0.417 0.145	1 [referent] 5.35 [2.38-12.00] 1 [referent] 2.43 [0.36-16.63] 1 [referent] 1.13 [0.24-5.18] 2.84 [1.05-7.73] 1 [referent] 0.51 [0.09-2.75]	0.554 <0.001 0.364 0.880 0.041 0.431 0.065
Child Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language (No Yes Age Category at Time of 1 2 3 Total Number of Sibling 1 2	51 (33.77) 100 (66.23) 137 (90.73) 14 (9.27) Other Than Engl 139 (92.05) 12 (7.95) FAEDC Complet 40 (26.49) 98 (64.9) 13 (8.61) s 41 (27.15) 57 (37.75)	799 (53.09) 706 (46.91) 1,435 (95.35) 70 (4.65) ish at Home 1,377 (91.50) 128 (8.50) ion b 281 (18.67) 1,101 (73.16) 123 (8.17) 467 (31.03) 597 (39.67)	1 [referent] 5.21 [2.58-10.52] 1 [referent] 3.96 [0.86-18.29] 1 [referent] 0.67 [0.17-2.62] 2.42 [0.98-5.94] 1 [referent] 1.73 [0.46-6.48] Overall p-value 1 [referent] 1.27 [0.50-3.23]	0.481 <0.001 0.078 0.567 0.055 0.417 0.145	1 [referent] 5.35 [2.38-12.00] 1 [referent] 2.43 [0.36-16.63] 1 [referent] 1.13 [0.24-5.18] 2.84 [1.05-7.73] 1 [referent] 0.51 [0.09-2.75] Overall p-value	0.554 <0.001 0.364 0.880 0.041
Child Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language (No Yes Age Category at Time of 1 2 3 Total Number of Sibling 1 2 3	51 (33.77) 100 (66.23) 137 (90.73) 14 (9.27) Other Than Engl 139 (92.05) 12 (7.95) FAEDC Complet 40 (26.49) 98 (64.9) 13 (8.61) s 41 (27.15)	799 (53.09) 706 (46.91) 1,435 (95.35) 70 (4.65) ish at Home 1,377 (91.50) 128 (8.50) ion b 281 (18.67) 1,101 (73.16) 123 (8.17) 467 (31.03)	1 [referent] 5.21 [2.58-10.52] 1 [referent] 3.96 [0.86-18.29] 1 [referent] 0.67 [0.17-2.62] 2.42 [0.98-5.94] 1 [referent] 1.73 [0.46-6.48] Overall p-value 1 [referent]	0.481 <0.001 0.078 0.567 0.055 0.417 0.145	1 [referent] 5.35 [2.38-12.00] 1 [referent] 2.43 [0.36-16.63] 1 [referent] 1.13 [0.24-5.18] 2.84 [1.05-7.73] 1 [referent] 0.51 [0.09-2.75] Overall p-value 1 [referent]	0.554 <0.001 0.364 0.880 0.041 0.431 0.065
Child Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language (No Yes Age Category at Time of 1 2 3 Total Number of Sibling 1 2	51 (33.77) 100 (66.23) 137 (90.73) 14 (9.27) Other Than Engl 139 (92.05) 12 (7.95) FAEDC Complet 40 (26.49) 98 (64.9) 13 (8.61) s 41 (27.15) 57 (37.75)	799 (53.09) 706 (46.91) 1,435 (95.35) 70 (4.65) ish at Home 1,377 (91.50) 128 (8.50) ion b 281 (18.67) 1,101 (73.16) 123 (8.17) 467 (31.03) 597 (39.67)	1 [referent] 5.21 [2.58-10.52] 1 [referent] 3.96 [0.86-18.29] 1 [referent] 0.67 [0.17-2.62] 2.42 [0.98-5.94] 1 [referent] 1.73 [0.46-6.48] Overall p-value 1 [referent] 1.27 [0.50-3.23]	0.481 <0.001 0.078 0.567 0.055 0.417 0.145	1 [referent] 5.35 [2.38-12.00] 1 [referent] 2.43 [0.36-16.63] 1 [referent] 1.13 [0.24-5.18] 2.84 [1.05-7.73] 1 [referent] 0.51 [0.09-2.75] Overall p-value 1 [referent] 1.97 [0.52-7.49]	0.554 <0.001 0.364 0.880 0.041 0.431 0.065
Child Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language of No Yes Age Category at Time of 1 2 3 Total Number of Sibling 1 2 3 >3 >3	51 (33.77) 100 (66.23) 137 (90.73) 14 (9.27) Other Than Engl 139 (92.05) 12 (7.95) FAEDC Complet 40 (26.49) 98 (64.9) 13 (8.61) S 41 (27.15) 57 (37.75) 27 (17.88)	799 (53.09) 706 (46.91) 1,435 (95.35) 70 (4.65) ish at Home 1,377 (91.50) 128 (8.50) ion b 281 (18.67) 1,101 (73.16) 123 (8.17) 467 (31.03) 597 (39.67) 287 (19.07)	1 [referent] 5.21 [2.58-10.52] 1 [referent] 3.96 [0.86-18.29] 1 [referent] 0.67 [0.17-2.62] 2.42 [0.98-5.94] 1 [referent] 1.73 [0.46-6.48] Overall p-value 1 [referent] 1.27 [0.50-3.23] 1.27 [0.41-3.91]	0.481 <0.001 0.078 0.567 0.055 0.417 0.145 0.613 0.678	1 [referent] 5.35 [2.38-12.00] 1 [referent] 2.43 [0.36-16.63] 1 [referent] 1.13 [0.24-5.18] 2.84 [1.05-7.73] 1 [referent] 0.51 [0.09-2.75] Overall p-value 1 [referent] 1.97 [0.52-7.49] 0.91 [0.16-5.21]	0.554 <0.001 0.364 0.880 0.041 0.431 0.065 0.322 0.915
Child Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language (No Yes Age Category at Time of 1 2 3 Total Number of Sibling 1 2 3	51 (33.77) 100 (66.23) 137 (90.73) 14 (9.27) Other Than Engl 139 (92.05) 12 (7.95) FAEDC Complet 40 (26.49) 98 (64.9) 13 (8.61) S 41 (27.15) 57 (37.75) 27 (17.88)	799 (53.09) 706 (46.91) 1,435 (95.35) 70 (4.65) ish at Home 1,377 (91.50) 128 (8.50) ion b 281 (18.67) 1,101 (73.16) 123 (8.17) 467 (31.03) 597 (39.67) 287 (19.07)	1 [referent] 5.21 [2.58-10.52] 1 [referent] 3.96 [0.86-18.29] 1 [referent] 0.67 [0.17-2.62] 2.42 [0.98-5.94] 1 [referent] 1.73 [0.46-6.48] Overall p-value 1 [referent] 1.27 [0.50-3.23] 1.27 [0.41-3.91] 4.06 [1.14-14.39]	0.481 <0.001 0.078 0.567 0.055 0.417 0.145 0.613 0.678 0.030	1 [referent] 5.35 [2.38-12.00] 1 [referent] 2.43 [0.36-16.63] 1 [referent] 1.13 [0.24-5.18] 2.84 [1.05-7.73] 1 [referent] 0.51 [0.09-2.75] Overall p-value 1 [referent] 1.97 [0.52-7.49] 0.91 [0.16-5.21] 2.53 [0.33-19.66]	0.554 <0.001 0.364 0.880 0.041 0.431 0.065 0.322 0.915 0.374
Child Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language of No Yes Age Category at Time of 1 2 3 Total Number of Sibling 1 2 3 >3 >3	51 (33.77) 100 (66.23) 137 (90.73) 14 (9.27) Other Than Engl 139 (92.05) 12 (7.95) FAEDC Complet 40 (26.49) 98 (64.9) 13 (8.61) s 41 (27.15) 57 (37.75) 27 (17.88) 26 (17.22)	799 (53.09) 706 (46.91) 1,435 (95.35) 70 (4.65) ish at Home 1,377 (91.50) 128 (8.50) ion b 281 (18.67) 1,101 (73.16) 123 (8.17) 467 (31.03) 597 (39.67) 287 (19.07) 154 (10.23)	1 [referent] 5.21 [2.58-10.52] 1 [referent] 3.96 [0.86-18.29] 1 [referent] 0.67 [0.17-2.62] 2.42 [0.98-5.94] 1 [referent] 1.73 [0.46-6.48] Overall p-value 1 [referent] 1.27 [0.50-3.23] 1.27 [0.41-3.91] 4.06 [1.14-14.39]	0.481 <0.001 0.078 0.567 0.055 0.417 0.145 0.613 0.678 0.030	1 [referent] 5.35 [2.38-12.00] 1 [referent] 2.43 [0.36-16.63] 1 [referent] 1.13 [0.24-5.18] 2.84 [1.05-7.73] 1 [referent] 0.51 [0.09-2.75] Overall p-value 1 [referent] 1.97 [0.52-7.49] 0.91 [0.16-5.21] 2.53 [0.33-19.66]	0.554 <0.001 0.364 0.880 0.041 0.431 0.065 0.322 0.915 0.374
Child Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language of No Yes Age Category at Time of 1 2 3 Total Number of Sibling 1 2 3 >3 Sociodemographic	51 (33.77) 100 (66.23) 137 (90.73) 14 (9.27) Other Than Engl 139 (92.05) 12 (7.95) FAEDC Complet 40 (26.49) 98 (64.9) 13 (8.61) s 41 (27.15) 57 (37.75) 27 (17.88) 26 (17.22)	799 (53.09) 706 (46.91) 1,435 (95.35) 70 (4.65) ish at Home 1,377 (91.50) 128 (8.50) ion b 281 (18.67) 1,101 (73.16) 123 (8.17) 467 (31.03) 597 (39.67) 287 (19.07) 154 (10.23)	1 [referent] 5.21 [2.58-10.52] 1 [referent] 3.96 [0.86-18.29] 1 [referent] 0.67 [0.17-2.62] 2.42 [0.98-5.94] 1 [referent] 1.73 [0.46-6.48] Overall p-value 1 [referent] 1.27 [0.50-3.23] 1.27 [0.41-3.91] 4.06 [1.14-14.39]	0.481 <0.001 0.078 0.567 0.055 0.417 0.145 0.613 0.678 0.030	1 [referent] 5.35 [2.38-12.00] 1 [referent] 2.43 [0.36-16.63] 1 [referent] 1.13 [0.24-5.18] 2.84 [1.05-7.73] 1 [referent] 0.51 [0.09-2.75] Overall p-value 1 [referent] 1.97 [0.52-7.49] 0.91 [0.16-5.21] 2.53 [0.33-19.66]	0.554 <0.001 0.364 0.880 0.041 0.431 0.065 0.322 0.915 0.374
Child Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language (No Yes Age Category at Time of 1 2 3 Total Number of Sibling 1 2 3 >3 Sociodemographic Index of Relative Sociode	51 (33.77) 100 (66.23) 137 (90.73) 14 (9.27) Other Than Engl 139 (92.05) 12 (7.95) FAEDC Complet 40 (26.49) 98 (64.9) 13 (8.61) S 41 (27.15) 57 (37.75) 27 (17.88) 26 (17.22)	799 (53.09) 706 (46.91) 1,435 (95.35) 70 (4.65) ish at Home 1,377 (91.50) 128 (8.50) ion b 281 (18.67) 1,101 (73.16) 123 (8.17) 467 (31.03) 597 (39.67) 287 (19.07) 154 (10.23)	1 [referent] 5.21 [2.58-10.52] 1 [referent] 3.96 [0.86-18.29] 1 [referent] 0.67 [0.17-2.62] 2.42 [0.98-5.94] 1 [referent] 1.73 [0.46-6.48] Overall p-value 1 [referent] 1.27 [0.50-3.23] 1.27 [0.41-3.91] 4.06 [1.14-14.39] Overall p-value	0.481 <0.001 0.078 0.567 0.055 0.417 0.145 0.613 0.678 0.030 0.172	1 [referent] 5.35 [2.38-12.00] 1 [referent] 2.43 [0.36-16.63] 1 [referent] 1.13 [0.24-5.18] 2.84 [1.05-7.73] 1 [referent] 0.51 [0.09-2.75] Overall p-value 1 [referent] 1.97 [0.52-7.49] 0.91 [0.16-5.21] 2.53 [0.33-19.66] Overall p-value	0.554 <0.001 0.364 0.880 0.041 0.431 0.065 0.322 0.915 0.374 0.417
Child Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language of No Yes Age Category at Time of 1 2 3 Total Number of Sibling 1 2 3 >3 Sociodemographic Index of Relative Socioe Lowest Quintile	51 (33.77) 100 (66.23) 137 (90.73) 14 (9.27) Other Than Engl 139 (92.05) 12 (7.95) FAEDC Complet 40 (26.49) 98 (64.9) 13 (8.61) s 41 (27.15) 57 (37.75) 27 (17.88) 26 (17.22) economic Disadv 118 (78.15)	799 (53.09) 706 (46.91) 1,435 (95.35) 70 (4.65) ish at Home 1,377 (91.50) 128 (8.50) ion b 281 (18.67) 1,101 (73.16) 123 (8.17) 467 (31.03) 597 (39.67) 287 (19.07) 154 (10.23) /antage 1,255 (83.39)	1 [referent] 5.21 [2.58-10.52] 1 [referent] 3.96 [0.86-18.29] 1 [referent] 0.67 [0.17-2.62] 2.42 [0.98-5.94] 1 [referent] 1.73 [0.46-6.48] Overall p-value 1 [referent] 1.27 [0.50-3.23] 1.27 [0.41-3.91] 4.06 [1.14-14.39] Overall p-value	0.481 <0.001 0.078 0.567 0.055 0.417 0.145 0.613 0.678 0.030 0.172	1 [referent] 5.35 [2.38-12.00] 1 [referent] 2.43 [0.36-16.63] 1 [referent] 1.13 [0.24-5.18] 2.84 [1.05-7.73] 1 [referent] 0.51 [0.09-2.75] Overall p-value 1 [referent] 1.97 [0.52-7.49] 0.91 [0.16-5.21] 2.53 [0.33-19.66] Overall p-value 0.72 [0.21-2.45]	0.554 <0.001 0.364 0.880 0.041 0.431 0.065 0.322 0.915 0.374 0.417

a Excluded from multivariable analysis due to small N.

b Age categories classified as; 1) ≥3 years 10 months to <5 years and one month, 2) ≥5 years and one month to <5 years and 10 months (reference category), 3) ≥5 years and 10 months to <6 years 10 months.

Table 3. Risk Factors for Developmental Vulnerability on the Emotional Maturity Domain.

Table 3. Risk Factors	DV	NDV	Bivariate	mai iviatul	Multivariable	
Characteristic	(N=147)	(N=1,509)	Sivariate		(N=1,352)	
Characteristic	N (%)	N (%)	OR [95% CI]	p-value	aOR [95% CI]	p-value
Maternal	11 (73)	11 (70)	Oit [55% Ci]	p value	uerr [5570 er]	p value
Age at Time of Child's Bi	irth (vears)					
<25	39 (26.53)	183 (12.13)	3.14 [1.44-6.89]	0.004	1.89 [0.70-5.05]	0.206
25-29	31 (21.09)	353 (23.39)	1 [referent]		1 [referent]	
30-34	38 (25.85)	568 (37.64)	0.70 [0.35-1.40]	0.311	1.03 [0.46-2.34]	0.937
≥35	39 (26.53)	405 (26.84)	1.12 [0.55-2.27]	0.762	1.16 [0.48-2.81]	0.742
	(20.00)	(=====,	Overall p-value	0.001	Overall p-value	0.611
Marital Status			Г Р		F	
Married (inc. de facto)	111 (75.51)	1,369 (90.72)	1 [referent]		1 [referent]	
All Other	34 (23.13)	136 (9.01)	4.58 [2.26-9.27]	<0.001	3.77 [1.48-9.58]	0.006
Unavailable	2 (1.36)	4 (0.27)				
Occupational Status Sca						
0-20	45 (30.61)	264 (17.50)	2.62 [1.46-4.72]	0.001	1.85 [0.86-3.97]	0.113
>20-100	95 (64.63)	1,190 (78.86)	1 [referent]		1 [referent]	
Unavailable	7 (4.76)	55 (3.64)			•	
Pregnancy & Birth						
Fertility Treatments		4				
No	126 (85.71)	1,262 (83.63)	1 [referent]		1 [referent]	
Yes	21 (14.29)	247 (16.37)	0.81 [0.40-1.66]	0.567	1.03 [0.42-2.53]	0.957
Smoking Status During F	Pregnancy					
No	118 (80.27)	1,300 (86.15)	1 [referent]		1 [referent]	
Yes	29 (19.73)	209 (13.85)	1.70 [0.86-3.36]	0.130	0.82 [0.33-2.02]	0.662
Pre-eclampsia						
No	129 (87.76)	1,331 (88.20)	1 [referent]		1 [referent]	
Yes	18 (12.24)	178 (11.80)	1.09 [0.50-2.40]	0.827	1.87 [0.75-4.63]	0.176
Gestational Diabetes						
No	138 (93.88)	1,416 (93.84)	1 [referent]		1 [referent]	
Yes	9 (6.12)	93 (6.16)	1.02 [0.35-2.97]	0.975	1.18 [0.37-3.76]	0.785
Threatened Abortion						
No	140 (95.24)	1,432 (94.90)	1 [referent]		1 [referent]	
Yes	7 (4.76)	77 (5.10)	0.91 [0.28-3.03]	0.882	0.09 [0.01-1.06]	0.055
Other Pregnancy Related	d Complications					
No	35 (23.81)	541 (35.85)	1 [referent]		1 [referent]	
Yes	112 (76.19)	968 (64.15)	2.13 [1.20-3.80]	0.010	1.80 [0.86-3.78]	0.121
Threatened Preterm Lab	oour					
No	125 (85.03)	1,339 (88.73)	1 [referent]		1 [referent]	
Yes	22 (14.97)	170 (11.27)	1.52 [0.72-3.25]	0.274	1.21 [0.51-2.85]	0.664
APH			•			
No	139 (94.56)	1,459 (96.69)	1 [referent]		1 [referent]	
Yes	8 (5.44)	50 (3.31)	2.13 [0.62-7.31]	0.230	0.67 [0.13-3.31]	0.618
Placenta Praevia a	1					
No	146 (99.32)	1,500 (99.40)				
Yes	1 (0.68)	9 (0.60)				
Placental Abruption a		1				
No	145 (98.64)	1,505 (99.73)				
Yes	2 (1.36)	4 (0.27)				
Fetal Distress	1	1	T			
No	128 (87.07)	1,390 (92.11)	1 [referent]		1 [referent]	1
Yes	19 (12.93)	119 (7.89)	1.95 [0.86-4.44]	0.111	1.09 [0.40-2.93]	0.869
Cephalopelvic Dispropor						
No	147 (100.00)	1,505 (99.73)				
Yes	0 (0.00)	4 (0.27)				
Prolapsed Cord a						
No	145 (98.64)	1,498 (99.27)				

1						
Yes	2 (1.36)	11 (0.73)				
Precipitate Delivery a	1	1				
No	146 (99.32)	1,484 (98.34)				
Yes	1 (0.68)	25 (1.66)				
PPH ≥500mls		T			<u></u>	
No	95 (64.63)	1,104 (73.16)	1 [referent]		1 [referent]	
Yes	52 (35.37)	405 (26.84)	1.75 [1.01-3.05]	0.047	1.03 [0.52-2.03]	0.932
TSR ≥2mins						
No	119 (80.95)	1,305 (86.48)	1 [referent]		1 [referent]	
Yes	28 (19.05)	204 (13.52)	1.69 [0.91-3.15]	0.096	1.12 [0.45-2.74]	0.812
Apgar 5-minutes <7 a						
No	143 (97.28)	1,480 (98.08)				
Yes	4 (2.72)	29 (1.92)				
Intubation	•	•		•		•
No	114 (77.55)	1,275 (84.49)	1 [referent]		1 [referent]	
Yes	33 (22.45)	234 (15.51)	1.78 [0.98-3.21]	0.057	1.48 [0.63-3.49]	0.366
Early Preterm Birth			-			•
No	119 (80.95)	1,291 (85.55)	1 [referent]		1 [referent]	
Yes	28 (19.05)	218 (14.45)	1.51 [0.76-3.00]	0.237	0.95 [0.42-2.13]	0.897
POBW <15 th Percentile		<u>, , , , , , , , , , , , , , , , , , , </u>	<u> </u>			1
No	106 (72.11)	1,125 (74.55)	1 [referent]		1 [referent]	
Yes	24 (16.33)	193 (12.79)	1.48 [0.76-2.87]	0.252	1.59 [0.77-3.30]	0.210
Unavailable	17 (11.56)	191 (12.66)				
Parity	, ,					
0	61 (41.5)	601 (39.83)	1 [referent]		1 [referent]	
1	52 (35.37)	531 (35.19)	0.99 [0.55-1.78]	0.968	0.86 [0.36-2.03]	0.723
≥2	34 (23.13)	377 (24.98)	0.89 [0.46-1.72]	0.727	0.84 [0.24-2.95]	0.786
	1 - (/		Overall p-value	0.934	Overall p-value	0.935
			T T T T T T T T T T T T T T T T T T T	1 0100	- Control process	
Child						
Child Sex						
Sex	32 (21.77)	818 (54.21)	1 [referent]		1 [referent]	
Sex Female	32 (21.77) 115 (78.23)	818 (54.21) 691 (45.79)	1 [referent] 10.13 [4.94-20.79]	<0.001	1 [referent] 9.37 [4.42-19.87]	<0.001
Sex Female Male	32 (21.77) 115 (78.23)	818 (54.21) 691 (45.79)	1 [referent] 10.13 [4.94-20.79]	<0.001	1 [referent] 9.37 [4.42-19.87]	<0.001
Sex Female Male Ethnicity	115 (78.23)	691 (45.79)	10.13 [4.94-20.79]	<0.001	9.37 [4.42-19.87]	<0.001
Sex Female Male Ethnicity Other	115 (78.23) 131 (89.12)	691 (45.79) 1,441 (95.49)	10.13 [4.94-20.79] 1 [referent]		9.37 [4.42-19.87] 1 [referent]	
Sex Female Male Ethnicity Other Indigenous Australian	115 (78.23) 131 (89.12) 16 (10.88)	691 (45.79) 1,441 (95.49) 68 (4.51)	10.13 [4.94-20.79]	<0.001	9.37 [4.42-19.87]	<0.001
Female Male Ethnicity Other Indigenous Australian Child Speaks Language (115 (78.23) 131 (89.12) 16 (10.88) Other Than Englis	691 (45.79) 1,441 (95.49) 68 (4.51) th at Home	10.13 [4.94-20.79] 1 [referent] 3.62 [1.36-9.62]		9.37 [4.42-19.87] 1 [referent] 5.61 [1.48-21.31]	
Female Male Ethnicity Other Indigenous Australian Child Speaks Language (No	115 (78.23) 131 (89.12) 16 (10.88) Other Than Englis 135 (91.84)	691 (45.79) 1,441 (95.49) 68 (4.51) th at Home 1,381 (91.52)	10.13 [4.94-20.79] 1 [referent] 3.62 [1.36-9.62] 1 [referent]	0.010	9.37 [4.42-19.87] 1 [referent] 5.61 [1.48-21.31] 1 [referent]	0.012
Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language (No Yes	115 (78.23) 131 (89.12) 16 (10.88) Other Than Englis 135 (91.84) 12 (8.16)	691 (45.79) 1,441 (95.49) 68 (4.51) th at Home 1,381 (91.52) 128 (8.48)	10.13 [4.94-20.79] 1 [referent] 3.62 [1.36-9.62]		9.37 [4.42-19.87] 1 [referent] 5.61 [1.48-21.31]	
Female Male Ethnicity Other Indigenous Australian Child Speaks Language (No	115 (78.23) 131 (89.12) 16 (10.88) Other Than Englis 135 (91.84) 12 (8.16) f AEDC Completion	691 (45.79) 1,441 (95.49) 68 (4.51) h at Home 1,381 (91.52) 128 (8.48) n b	10.13 [4.94-20.79] 1 [referent] 3.62 [1.36-9.62] 1 [referent] 1.00 [0.40-2.49]	0.010	9.37 [4.42-19.87] 1 [referent] 5.61 [1.48-21.31] 1 [referent] 1.02 [0.34-3.04]	0.012
Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language (No Yes Age Category at Time of	115 (78.23) 131 (89.12) 16 (10.88) Other Than Englis 135 (91.84) 12 (8.16) f AEDC Completion 37 (25.17)	691 (45.79) 1,441 (95.49) 68 (4.51) h at Home 1,381 (91.52) 128 (8.48) h b 284 (18.82)	10.13 [4.94-20.79] 1 [referent] 3.62 [1.36-9.62] 1 [referent] 1.00 [0.40-2.49] 1.57 [0.85-2.90]	0.010	9.37 [4.42-19.87] 1 [referent] 5.61 [1.48-21.31] 1 [referent] 1.02 [0.34-3.04] 1.38 [0.68-2.80]	0.012
Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language (No Yes Age Category at Time of 1 2	115 (78.23) 131 (89.12) 16 (10.88) Other Than Englis 135 (91.84) 12 (8.16) f AEDC Completion 37 (25.17) 102 (69.39)	1,441 (95.49) 68 (4.51) 6h at Home 1,381 (91.52) 128 (8.48) 6h 284 (18.82) 1,097 (72.7)	10.13 [4.94-20.79] 1 [referent] 3.62 [1.36-9.62] 1 [referent] 1.00 [0.40-2.49] 1.57 [0.85-2.90] 1 [referent]	0.010	9.37 [4.42-19.87] 1 [referent] 5.61 [1.48-21.31] 1 [referent] 1.02 [0.34-3.04] 1.38 [0.68-2.80] 1 [referent]	0.012 0.975 0.377
Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language (No Yes Age Category at Time of	115 (78.23) 131 (89.12) 16 (10.88) Other Than Englis 135 (91.84) 12 (8.16) f AEDC Completion 37 (25.17)	691 (45.79) 1,441 (95.49) 68 (4.51) h at Home 1,381 (91.52) 128 (8.48) h b 284 (18.82)	10.13 [4.94-20.79] 1 [referent] 3.62 [1.36-9.62] 1 [referent] 1.00 [0.40-2.49] 1.57 [0.85-2.90] 1 [referent] 0.62 [0.22-1.77]	0.010 0.994 0.148	9.37 [4.42-19.87] 1 [referent] 5.61 [1.48-21.31] 1 [referent] 1.02 [0.34-3.04] 1.38 [0.68-2.80] 1 [referent] 0.31 [0.08-1.17]	0.012 0.975 0.377
Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language (No Yes Age Category at Time of 1 2 3	115 (78.23) 131 (89.12) 16 (10.88) Other Than Englist 135 (91.84) 12 (8.16) f AEDC Completion 37 (25.17) 102 (69.39) 8 (5.44)	1,441 (95.49) 68 (4.51) 6h at Home 1,381 (91.52) 128 (8.48) 6h 284 (18.82) 1,097 (72.7)	10.13 [4.94-20.79] 1 [referent] 3.62 [1.36-9.62] 1 [referent] 1.00 [0.40-2.49] 1.57 [0.85-2.90] 1 [referent]	0.010	9.37 [4.42-19.87] 1 [referent] 5.61 [1.48-21.31] 1 [referent] 1.02 [0.34-3.04] 1.38 [0.68-2.80] 1 [referent]	0.012 0.975 0.377
Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language (No Yes Age Category at Time of 1 2 3 Total Number of Sibling	115 (78.23) 131 (89.12) 16 (10.88) Other Than Englis 135 (91.84) 12 (8.16) f AEDC Completion 37 (25.17) 102 (69.39) 8 (5.44)	691 (45.79) 1,441 (95.49) 68 (4.51) h at Home 1,381 (91.52) 128 (8.48) n b 284 (18.82) 1,097 (72.7) 128 (8.48)	10.13 [4.94-20.79] 1 [referent] 3.62 [1.36-9.62] 1 [referent] 1.00 [0.40-2.49] 1.57 [0.85-2.90] 1 [referent] 0.62 [0.22-1.77] Overall p-value	0.010 0.994 0.148	9.37 [4.42-19.87] 1 [referent] 5.61 [1.48-21.31] 1 [referent] 1.02 [0.34-3.04] 1.38 [0.68-2.80] 1 [referent] 0.31 [0.08-1.17] Overall p-value	0.012 0.975 0.377
Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language (No Yes Age Category at Time of 1 2 3 Total Number of Sibling 1	115 (78.23) 131 (89.12) 16 (10.88) Other Than Englis 135 (91.84) 12 (8.16) FAEDC Completion 37 (25.17) 102 (69.39) 8 (5.44) S 45 (30.61)	1,441 (95.49) 68 (4.51) 68 (4.51) 6h at Home 1,381 (91.52) 128 (8.48) 6h 284 (18.82) 1,097 (72.7) 128 (8.48) 463 (30.68)	10.13 [4.94-20.79] 1 [referent] 3.62 [1.36-9.62] 1 [referent] 1.00 [0.40-2.49] 1.57 [0.85-2.90] 1 [referent] 0.62 [0.22-1.77] Overall p-value 1 [referent]	0.010 0.994 0.148 0.372 0.187	9.37 [4.42-19.87] 1 [referent] 5.61 [1.48-21.31] 1 [referent] 1.02 [0.34-3.04] 1.38 [0.68-2.80] 1 [referent] 0.31 [0.08-1.17] Overall p-value 1 [referent]	0.012 0.975 0.377 0.085 0.122
Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language (No Yes Age Category at Time of 1 2 3 Total Number of Sibling 1 2	115 (78.23) 131 (89.12) 16 (10.88) Other Than Englis 135 (91.84) 12 (8.16) f AEDC Completio 37 (25.17) 102 (69.39) 8 (5.44) s 45 (30.61) 59 (40.14)	691 (45.79) 1,441 (95.49) 68 (4.51) h at Home 1,381 (91.52) 128 (8.48) n b 284 (18.82) 1,097 (72.7) 128 (8.48) 463 (30.68) 595 (39.43)	10.13 [4.94-20.79] 1 [referent] 3.62 [1.36-9.62] 1 [referent] 1.00 [0.40-2.49] 1.57 [0.85-2.90] 1 [referent] 0.62 [0.22-1.77] Overall p-value 1 [referent] 1.05 [0.57-1.95]	0.010 0.994 0.148 0.372 0.187	9.37 [4.42-19.87] 1 [referent] 5.61 [1.48-21.31] 1 [referent] 1.02 [0.34-3.04] 1.38 [0.68-2.80] 1 [referent] 0.31 [0.08-1.17] Overall p-value 1 [referent] 1.72 [0.69-4.25]	0.012 0.975 0.377 0.085 0.122
Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language (No Yes Age Category at Time of 1 2 3 Total Number of Sibling 1 2 3	115 (78.23) 131 (89.12) 16 (10.88) Other Than Englist 135 (91.84) 12 (8.16) f AEDC Completion 37 (25.17) 102 (69.39) 8 (5.44) s 45 (30.61) 59 (40.14) 22 (14.97)	691 (45.79) 1,441 (95.49) 68 (4.51) 6h at Home 1,381 (91.52) 128 (8.48) 1,097 (72.7) 128 (8.48) 463 (30.68) 595 (39.43) 292 (19.35)	10.13 [4.94-20.79] 1 [referent] 3.62 [1.36-9.62] 1 [referent] 1.00 [0.40-2.49] 1.57 [0.85-2.90] 1 [referent] 0.62 [0.22-1.77] Overall p-value 1 [referent] 1.05 [0.57-1.95] 0.71 [0.32-1.57]	0.010 0.994 0.148 0.372 0.187 0.873 0.400	9.37 [4.42-19.87] 1 [referent] 5.61 [1.48-21.31] 1 [referent] 1.02 [0.34-3.04] 1.38 [0.68-2.80] 1 [referent] 0.31 [0.08-1.17] Overall p-value 1 [referent] 1.72 [0.69-4.25] 0.95 [0.28-3.24]	0.012 0.975 0.377 0.085 0.122 0.241 0.935
Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language (No Yes Age Category at Time of 1 2 3 Total Number of Sibling 1 2	115 (78.23) 131 (89.12) 16 (10.88) Other Than Englis 135 (91.84) 12 (8.16) f AEDC Completio 37 (25.17) 102 (69.39) 8 (5.44) s 45 (30.61) 59 (40.14)	691 (45.79) 1,441 (95.49) 68 (4.51) h at Home 1,381 (91.52) 128 (8.48) n b 284 (18.82) 1,097 (72.7) 128 (8.48) 463 (30.68) 595 (39.43)	10.13 [4.94-20.79] 1 [referent] 3.62 [1.36-9.62] 1 [referent] 1.00 [0.40-2.49] 1.57 [0.85-2.90] 1 [referent] 0.62 [0.22-1.77] Overall p-value 1 [referent] 1.05 [0.57-1.95] 0.71 [0.32-1.57] 1.62 [0.69-3.80]	0.010 0.994 0.148 0.372 0.187 0.873 0.400 0.270	9.37 [4.42-19.87] 1 [referent] 5.61 [1.48-21.31] 1 [referent] 1.02 [0.34-3.04] 1.38 [0.68-2.80] 1 [referent] 0.31 [0.08-1.17] Overall p-value 1 [referent] 1.72 [0.69-4.25] 0.95 [0.28-3.24] 1.93 [0.46-8.19]	0.012 0.975 0.377 0.085 0.122 0.241 0.935 0.370
Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language (No Yes Age Category at Time of 1 2 3 Total Number of Sibling 1 2 3 >3	115 (78.23) 131 (89.12) 16 (10.88) Other Than Englist 135 (91.84) 12 (8.16) f AEDC Completion 37 (25.17) 102 (69.39) 8 (5.44) s 45 (30.61) 59 (40.14) 22 (14.97)	691 (45.79) 1,441 (95.49) 68 (4.51) 6h at Home 1,381 (91.52) 128 (8.48) 1,097 (72.7) 128 (8.48) 463 (30.68) 595 (39.43) 292 (19.35)	10.13 [4.94-20.79] 1 [referent] 3.62 [1.36-9.62] 1 [referent] 1.00 [0.40-2.49] 1.57 [0.85-2.90] 1 [referent] 0.62 [0.22-1.77] Overall p-value 1 [referent] 1.05 [0.57-1.95] 0.71 [0.32-1.57]	0.010 0.994 0.148 0.372 0.187 0.873 0.400	9.37 [4.42-19.87] 1 [referent] 5.61 [1.48-21.31] 1 [referent] 1.02 [0.34-3.04] 1.38 [0.68-2.80] 1 [referent] 0.31 [0.08-1.17] Overall p-value 1 [referent] 1.72 [0.69-4.25] 0.95 [0.28-3.24]	0.012 0.975 0.377 0.085 0.122 0.241 0.935
Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language (No Yes Age Category at Time of 1 2 3 Total Number of Sibling 1 2 3 >3 Sociodemographic	115 (78.23) 131 (89.12) 16 (10.88) Other Than Englis 135 (91.84) 12 (8.16) f AEDC Completio 37 (25.17) 102 (69.39) 8 (5.44) s 45 (30.61) 59 (40.14) 22 (14.97) 21 (14.29)	1,441 (95.49) 68 (4.51) 68 (4.51) 6 at Home 1,381 (91.52) 128 (8.48) 6 b 284 (18.82) 1,097 (72.7) 128 (8.48) 463 (30.68) 595 (39.43) 292 (19.35) 159 (10.54)	10.13 [4.94-20.79] 1 [referent] 3.62 [1.36-9.62] 1 [referent] 1.00 [0.40-2.49] 1.57 [0.85-2.90] 1 [referent] 0.62 [0.22-1.77] Overall p-value 1 [referent] 1.05 [0.57-1.95] 0.71 [0.32-1.57] 1.62 [0.69-3.80]	0.010 0.994 0.148 0.372 0.187 0.873 0.400 0.270	9.37 [4.42-19.87] 1 [referent] 5.61 [1.48-21.31] 1 [referent] 1.02 [0.34-3.04] 1.38 [0.68-2.80] 1 [referent] 0.31 [0.08-1.17] Overall p-value 1 [referent] 1.72 [0.69-4.25] 0.95 [0.28-3.24] 1.93 [0.46-8.19]	0.012 0.975 0.377 0.085 0.122 0.241 0.935 0.370
Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language (No Yes Age Category at Time of 1 2 3 Total Number of Sibling 1 2 3 >3 Sociodemographic Index of Relative Socioe	115 (78.23) 131 (89.12) 16 (10.88) Other Than Englis 135 (91.84) 12 (8.16) F AEDC Completio 37 (25.17) 102 (69.39) 8 (5.44) s 45 (30.61) 59 (40.14) 22 (14.97) 21 (14.29) economic Disadva	691 (45.79) 1,441 (95.49) 68 (4.51) th at Home 1,381 (91.52) 128 (8.48) th b 284 (18.82) 1,097 (72.7) 128 (8.48) 463 (30.68) 595 (39.43) 292 (19.35) 159 (10.54)	10.13 [4.94-20.79] 1 [referent] 3.62 [1.36-9.62] 1 [referent] 1.00 [0.40-2.49] 1.57 [0.85-2.90] 1 [referent] 0.62 [0.22-1.77] Overall p-value 1 [referent] 1.05 [0.57-1.95] 0.71 [0.32-1.57] 1.62 [0.69-3.80] Overall p-value	0.010 0.994 0.148 0.372 0.187 0.873 0.400 0.270 0.423	9.37 [4.42-19.87] 1 [referent] 5.61 [1.48-21.31] 1 [referent] 1.02 [0.34-3.04] 1.38 [0.68-2.80] 1 [referent] 0.31 [0.08-1.17] Overall p-value 1 [referent] 1.72 [0.69-4.25] 0.95 [0.28-3.24] 1.93 [0.46-8.19] Overall p-value	0.012 0.975 0.377 0.085 0.122 0.241 0.935 0.370 0.356
Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language (No Yes Age Category at Time of 1 2 3 Total Number of Sibling 1 2 3 >3 Sociodemographic Index of Relative Socioe Lowest Quintile	115 (78.23) 131 (89.12) 16 (10.88) Other Than Englis 135 (91.84) 12 (8.16) FAEDC Completio 37 (25.17) 102 (69.39) 8 (5.44) S 45 (30.61) 59 (40.14) 22 (14.97) 21 (14.29) economic Disadva 118 (80.27)	1,441 (95.49) 68 (4.51) 68 (4.51) 6h at Home 1,381 (91.52) 128 (8.48) 6h 284 (18.82) 1,097 (72.7) 128 (8.48) 463 (30.68) 595 (39.43) 292 (19.35) 159 (10.54) entage 1,255 (83.17)	10.13 [4.94-20.79] 1 [referent] 3.62 [1.36-9.62] 1 [referent] 1.00 [0.40-2.49] 1.57 [0.85-2.90] 1 [referent] 0.62 [0.22-1.77] Overall p-value 1 [referent] 1.05 [0.57-1.95] 0.71 [0.32-1.57] 1.62 [0.69-3.80] Overall p-value 1.08 [0.54-2.17]	0.010 0.994 0.148 0.372 0.187 0.873 0.400 0.270	9.37 [4.42-19.87] 1 [referent] 5.61 [1.48-21.31] 1 [referent] 1.02 [0.34-3.04] 1.38 [0.68-2.80] 1 [referent] 0.31 [0.08-1.17] Overall p-value 1 [referent] 1.72 [0.69-4.25] 0.95 [0.28-3.24] 1.93 [0.46-8.19] Overall p-value 0.58 [0.24-1.43]	0.012 0.975 0.377 0.085 0.122 0.241 0.935 0.370
Sex Female Male Ethnicity Other Indigenous Australian Child Speaks Language (No Yes Age Category at Time of 1 2 3 Total Number of Sibling 1 2 3 >3 Sociodemographic Index of Relative Sociode	115 (78.23) 131 (89.12) 16 (10.88) Other Than Englis 135 (91.84) 12 (8.16) F AEDC Completio 37 (25.17) 102 (69.39) 8 (5.44) s 45 (30.61) 59 (40.14) 22 (14.97) 21 (14.29) economic Disadva	691 (45.79) 1,441 (95.49) 68 (4.51) th at Home 1,381 (91.52) 128 (8.48) th b 284 (18.82) 1,097 (72.7) 128 (8.48) 463 (30.68) 595 (39.43) 292 (19.35) 159 (10.54)	10.13 [4.94-20.79] 1 [referent] 3.62 [1.36-9.62] 1 [referent] 1.00 [0.40-2.49] 1.57 [0.85-2.90] 1 [referent] 0.62 [0.22-1.77] Overall p-value 1 [referent] 1.05 [0.57-1.95] 0.71 [0.32-1.57] 1.62 [0.69-3.80] Overall p-value	0.010 0.994 0.148 0.372 0.187 0.873 0.400 0.270 0.423	9.37 [4.42-19.87] 1 [referent] 5.61 [1.48-21.31] 1 [referent] 1.02 [0.34-3.04] 1.38 [0.68-2.80] 1 [referent] 0.31 [0.08-1.17] Overall p-value 1 [referent] 1.72 [0.69-4.25] 0.95 [0.28-3.24] 1.93 [0.46-8.19] Overall p-value	0.012 0.975 0.377 0.085 0.122 0.241 0.935 0.370 0.356

a Excluded from multivariable analysis due to small N.

b Age categories classified as; 1) ≥3 years 10 months to <5 years and one month, 2) ≥5 years and one month to <5 years and 10 months (reference category), 3) ≥5 years and 10 months to <6 years 10 months.

Table 4. Risk Factors for Developmental Vulnerability on the Language & Cognitive Skills (school-based) Domain.

based) Domain.	•					
	DV	NDV	Bivariate		Multivariable	
Characteristic	(N=195)	(N=1,461)		1	(N=1,352)	1
	N (%)	N (%)	OR [95% CI]	p-value	aOR [95% CI]	p-value
Maternal						
Age at Time of Child's E		T	Γ	Т	T	
<25	68 (34.87)	154 (10.54)	18.41 [5.21-65.05]	<0.001	12.90 [2.81-59.16]	0.001
25-29	38 (19.49)	346 (23.68)	1 [referent]	Т	1 [referent]	
30-34	52 (26.67)	554 (37.92)	0.72 [0.25-2.02]	0.528	0.80 [0.24-2.67]	0.716
≥35	37 (18.97)	407 (27.86)	0.70 [0.23-2.13]	0.528	0.98 [0.27-3.57]	0.970
			Overall p-value	<0.001	Overall p-value	0.003
Marital Status	1	T			T	
Married (inc. de facto)	145 (74.36)	1,335 (91.38)	1 [referent]		1 [referent]	
All Other	50 (25.64)	120 (8.21)	18.44 [5.70-59.63]	<0.001	5.92 [1.43-24.59]	0.014
Unavailable	0 (0.00)	6 (0.41)				
Occupational Status Sc	ale at Time of C	hild's Birth				
0-20	70 (35.90)	239 (16.36)	12.68 [4.58-35.09]	<0.001	3.61 [1.19-10.95]	0.024
>80-100	105 (53.85)	1,180 (80.77)	1 [referent]		1 [referent]	
Unavailable	20 (10.26)	42 (2.87)				
Pregnancy & Birth						
Fertility Treatments						
No	180 (92.31)	1,208 (82.68)	1 [referent]		1 [referent]	
Yes	15 (7.69)	253 (17.32)	0.16 [0.04-0.55]	0.004	0.42 [0.09-1.95]	0.264
Smoking Status During	Pregnancy					•
No	145 (74.36)	1,273 (87.13)	1 [referent]		1 [referent]	
Yes	50 (25.64)	188 (12.87)	6.35 [2.24-18.01]	<0.001	0.28 [0.07-1.09]	0.066
Pre-eclampsia	,	· · · · ·		1		
No	176 (90.26)	1,284 (87.89)	1 [referent]		1 [referent]	
Yes	19 (9.74)	177 (12.11)	0.61 [0.18-2.10]	0.434	1.09 [0.26-4.60]	0.908
Gestational Diabetes	- (- /	, ,				1 01000
No	184 (94.36)	1,370 (93.77)	1 [referent]		1 [referent]	
Yes	11 (5.64)	91 (6.23)	0.84 [0.16-4.44]	0.836	0.66 [0.11-4.01]	0.651
Threatened Abortion	(0.0.7	- ()	[0.20 ()	1	0.00 [0.2202]	0.002
No	189 (96.92)	1,383 (94.66)	1 [referent]		1 [referent]	
Yes	6 (3.08)	78 (5.34)	0.36 [0.05-2.41]	0.291	0.20 [0.01-3.32]	0.258
Other Pregnancy Relate	. ,	· · ·	0.50 [0.05 2.12]	0.232	0.20 [0.01 0.02]	0.230
No	53 (27.18)	523 (35.80)	1 [referent]		1 [referent]	
Yes	142 (72.82)	938 (64.20)	1.96 [0.84-4.54]	0.119	1.29 [0.45-3.71]	0.635
Threatened Preterm La		330 (04.20)	1.50 [0.04 4.54]	0.113	1.25 [0.45 5.71]	0.033
No	162 (83.08)	1,302 (89.12)	1 [referent]		1 [referent]	
Yes	33 (16.92)	159 (10.88)	3.21 [0.80-12.92]	0.100	1.20 [0.32-4.48]	0.782
APH	33 (10.32)	133 (10.00)	3.21 [0.00 12.32]	0.100	1.20 [0.32 4.40]	0.702
No	183 (93.85)	1,415 (96.85)	1 [referent]		1 [referent]	
Yes	12 (6.15)	46 (3.15)	6.80 [0.62-74.13]	0.116	4.92 [0.62-39.01]	0.131
Placenta Praevia	12 (0.13)	40 (3.13)	0.80 [0.02-74.13]	0.110	4.92 [0.02-39.01]	0.131
No	195 (100.00)	1,451 (99.32)				
	0 (0.00)					
Yes	0 (0.00)	10 (0.68)				
Placental Abruption	405 (400 00)	4 455 (00 50)				
No	195 (100.00)	1,455 (99.59)				
Yes	0 (0.00)	6 (0.41)				
Fetal Distress	170 (60 70)	4 0 45 (55 55)	4.5.6		4.5.6.13	
No	173 (88.72)	1,345 (92.06)	1 [referent]	T a a = =	1 [referent]	T
Yes	22 (11.28)	116 (7.94)	2.04 [0.45-9.17]	0.353	0.56 [0.11-2.76]	0.475
Cephalopelvic Dispropo						
No	195 (100.00)	1,457 (99.73)				
Yes	0 (0.00)	4 (0.27)				
Prolapsed Cord a						

	1					
No	192 (98.46)	1,451 (99.32)				
Yes	3 (1.54)	10 (0.68)				
Precipitate Delivery a		1				
No	190 (97.44)	1,440 (98.56)				
Yes	5 (2.56)	21 (1.44)				
PPH ≥500mls						
No	123 (63.08)	1,076 (73.65)	1 [referent]		1 [referent]	
Yes	72 (36.92)	385 (26.35)	3.13 [1.22-8.05]	0.018	1.84 [0.67-5.03]	0.237
TSR ≥2mins						
No	163 (83.59)	1,261 (86.31)	1 [referent]		1 [referent]	
Yes	32 (16.41)	200 (13.69)	0.95 [0.39-2.30]	0.908	0.62 [0.20-1.91]	0.399
Apgar 5-minutes <7 a						
No	193 (98.97)	1,430 (97.88)				
Yes	2 (1.03)	31 (2.12)				
Intubation						
No	159 (81.54)	1,230 (84.19)	1 [referent]		1 [referent]	
Yes	36 (18.46)	231 (15.81)	1.13 [0.49-2.58]	0.779	1.68 [0.59-4.81]	0.333
Early Preterm Birth						
No	155 (79.49)	1,255 (85.90)	1 [referent]		1 [referent]	
Yes	40 (20.51)	206 (14.10)	2.57 [0.75-8.80]	0.133	0.79 [0.23-2.80]	0.720
POBW <15 th Percentile						
No	142 (72.82)	1,089 (74.54)	1 [referent]		1 [referent]	
Yes	36 (18.46)	181 (12.39)	1.62 [0.72-3.66]	0.246	1.74 [0.71-4.25]	0.222
Unavailable	17 (8.72)	191 (13.07)				
Parity						
0	51 (26.15)	611 (41.82)	1 [referent]		1 [referent]	
1	81 (41.54)	502 (34.36)	4.67 [1.71-12.70]	0.003	5.12 [1.25-20.99]	0.023
≥2	63 (32.31)	348 (23.82)	6.18 [2.09-18.27]	0.001	6.37 [1.00-40.66]	0.050
	•		Overall p-value	0.002	Overall p-value	0.060
Child						
Sex						
Female	85 (43.59)	765 (52.36)	1 [referent]		1 [referent]	
Male	110 (56.41)	696 (47.64)	3.03 [1.60-5.71]	<0.001	3.57 [1.66-7.65]	0.001
Ethnicity						
Other	165 (84.62)	1,407 (96.30)	1 [referent]		1 [referent]	
Indigenous Australian	30 (15.38)	54 (3.70)	34.27 [7.49-156.82]	<0.001	2.22 [0.32-15.52]	0.420
Child Speaks Language	Other Than En	glish at Home				
No	167 (85.64)	1,349 (92.33)	1 [referent]		1 [referent]	
Yes	28 (14.36)	442 (7 (7)				
Age Category at Time of	20 (14.30)	112 (7.67)	3.82 [0.89-16.47]	0.072	2.14 [0.49-9.35]	0.313
4		· · · · · · · · · · · · · · · · · · ·	3.82 [0.89-16.47]	0.072	2.14 [0.49-9.35]	0.313
1		· · · · · · · · · · · · · · · · · · ·	2.09 [0.74-5.89]	0.072	2.14 [0.49-9.35]	0.313
2	of AEDC Comple	tion ^b				1
	48 (24.62)	273 (18.69)	2.09 [0.74-5.89]		2.18 [0.77-6.16]	1
2	of AEDC Comple 48 (24.62) 128 (65.64)	273 (18.69) 1,071 (73.31)	2.09 [0.74-5.89] 1 [referent]	0.164	2.18 [0.77-6.16] 1 [referent]	0.140
2	128 (65.64) 19 (9.74)	273 (18.69) 1,071 (73.31)	2.09 [0.74-5.89] 1 [referent] 2.56 [0.56-11.82]	0.164	2.18 [0.77-6.16] 1 [referent] 1.06 [0.22-5.19]	0.140
2 3	128 (65.64) 19 (9.74)	273 (18.69) 1,071 (73.31)	2.09 [0.74-5.89] 1 [referent] 2.56 [0.56-11.82]	0.164	2.18 [0.77-6.16] 1 [referent] 1.06 [0.22-5.19]	0.140
2 3 Total Number of Sibling	of AEDC Comple 48 (24.62) 128 (65.64) 19 (9.74) gs	273 (18.69) 1,071 (73.31) 117 (8.01)	2.09 [0.74-5.89] 1 [referent] 2.56 [0.56-11.82] Overall p-value	0.164	2.18 [0.77-6.16] 1 [referent] 1.06 [0.22-5.19] Overall p-value	0.140
2 3 Total Number of Sibling	of AEDC Comple 48 (24.62) 128 (65.64) 19 (9.74) gs 41 (21.03)	273 (18.69) 1,071 (73.31) 117 (8.01) 467 (31.96)	2.09 [0.74-5.89] 1 [referent] 2.56 [0.56-11.82] Overall p-value 1 [referent]	0.164 0.227 0.234	2.18 [0.77-6.16] 1 [referent] 1.06 [0.22-5.19] Overall p-value 1 [referent]	0.140 0.943 0.329
2 3 Total Number of Sibling 1 2	f AEDC Comple 48 (24.62) 128 (65.64) 19 (9.74) gs 41 (21.03) 79 (40.51)	273 (18.69) 1,071 (73.31) 117 (8.01) 467 (31.96) 575 (39.36)	2.09 [0.74-5.89] 1 [referent] 2.56 [0.56-11.82] Overall p-value 1 [referent] 2.82 [1.01-7.88]	0.164 0.227 0.234 0.048	2.18 [0.77-6.16] 1 [referent] 1.06 [0.22-5.19] Overall p-value 1 [referent] 0.63 [0.15-2.60]	0.140 0.943 0.329 0.523
2 3 Total Number of Sibling 1 2 3	48 (24.62) 128 (65.64) 19 (9.74) 19 (40.51) 35 (17.95)	273 (18.69) 1,071 (73.31) 117 (8.01) 467 (31.96) 575 (39.36) 279 (19.10)	2.09 [0.74-5.89] 1 [referent] 2.56 [0.56-11.82] Overall p-value 1 [referent] 2.82 [1.01-7.88] 2.40 [0.71-8.13]	0.164 0.227 0.234 0.048 0.160	2.18 [0.77-6.16] 1 [referent] 1.06 [0.22-5.19] Overall p-value 1 [referent] 0.63 [0.15-2.60] 0.23 [0.04-1.40]	0.140 0.943 0.329 0.523 0.110
2 3 Total Number of Sibling 1 2 3	48 (24.62) 128 (65.64) 19 (9.74) 19 (40.51) 35 (17.95)	273 (18.69) 1,071 (73.31) 117 (8.01) 467 (31.96) 575 (39.36) 279 (19.10)	2.09 [0.74-5.89] 1 [referent] 2.56 [0.56-11.82] Overall p-value 1 [referent] 2.82 [1.01-7.88] 2.40 [0.71-8.13] 17.34 [4.37-68.74]	0.164 0.227 0.234 0.048 0.160 <0.001	2.18 [0.77-6.16] 1 [referent] 1.06 [0.22-5.19] Overall p-value 1 [referent] 0.63 [0.15-2.60] 0.23 [0.04-1.40] 2.14 [0.29-15.84]	0.140 0.943 0.329 0.523 0.110 0.455
2 3 Total Number of Sibling 1 2 3 >3	ss 41 (21.03) 79 (40.51) 35 (17.95) 40 (20.51)	273 (18.69) 1,071 (73.31) 117 (8.01) 467 (31.96) 575 (39.36) 279 (19.10) 140 (9.58)	2.09 [0.74-5.89] 1 [referent] 2.56 [0.56-11.82] Overall p-value 1 [referent] 2.82 [1.01-7.88] 2.40 [0.71-8.13] 17.34 [4.37-68.74]	0.164 0.227 0.234 0.048 0.160 <0.001	2.18 [0.77-6.16] 1 [referent] 1.06 [0.22-5.19] Overall p-value 1 [referent] 0.63 [0.15-2.60] 0.23 [0.04-1.40] 2.14 [0.29-15.84]	0.140 0.943 0.329 0.523 0.110 0.455
2 3 Total Number of Sibling 1 2 3 >3 Sociodemographic	ss 41 (21.03) 79 (40.51) 35 (17.95) 40 (20.51)	273 (18.69) 1,071 (73.31) 117 (8.01) 467 (31.96) 575 (39.36) 279 (19.10) 140 (9.58)	2.09 [0.74-5.89] 1 [referent] 2.56 [0.56-11.82] Overall p-value 1 [referent] 2.82 [1.01-7.88] 2.40 [0.71-8.13] 17.34 [4.37-68.74]	0.164 0.227 0.234 0.048 0.160 <0.001	2.18 [0.77-6.16] 1 [referent] 1.06 [0.22-5.19] Overall p-value 1 [referent] 0.63 [0.15-2.60] 0.23 [0.04-1.40] 2.14 [0.29-15.84]	0.140 0.943 0.329 0.523 0.110 0.455
2 3 Total Number of Sibling 1 2 3 >3 Sociodemographic Index of Relative Socio	48 (24.62) 128 (65.64) 19 (9.74) 19 (9.74) 41 (21.03) 79 (40.51) 35 (17.95) 40 (20.51)	273 (18.69) 1,071 (73.31) 117 (8.01) 467 (31.96) 575 (39.36) 279 (19.10) 140 (9.58)	2.09 [0.74-5.89] 1 [referent] 2.56 [0.56-11.82] Overall p-value 1 [referent] 2.82 [1.01-7.88] 2.40 [0.71-8.13] 17.34 [4.37-68.74] Overall p-value	0.164 0.227 0.234 0.048 0.160 <0.001 <0.001	2.18 [0.77-6.16] 1 [referent] 1.06 [0.22-5.19] Overall p-value 1 [referent] 0.63 [0.15-2.60] 0.23 [0.04-1.40] 2.14 [0.29-15.84] Overall p-value	0.140 0.943 0.329 0.523 0.110 0.455 0.044
2 3 Total Number of Sibling 1 2 3 >3 Sociodemographic Index of Relative Socio Lowest Quintile	48 (24.62) 128 (65.64) 19 (9.74) 19 (9.74) 41 (21.03) 79 (40.51) 35 (17.95) 40 (20.51) economic Disace 141 (72.31)	tion b 273 (18.69) 1,071 (73.31) 117 (8.01) 467 (31.96) 575 (39.36) 279 (19.10) 140 (9.58) tvantage 1,232 (84.33)	2.09 [0.74-5.89] 1 [referent] 2.56 [0.56-11.82] Overall p-value 1 [referent] 2.82 [1.01-7.88] 2.40 [0.71-8.13] 17.34 [4.37-68.74] Overall p-value	0.164 0.227 0.234 0.048 0.160 <0.001 <0.001	2.18 [0.77-6.16] 1 [referent] 1.06 [0.22-5.19] Overall p-value 1 [referent] 0.63 [0.15-2.60] 0.23 [0.04-1.40] 2.14 [0.29-15.84] Overall p-value 1.52 [0.47-4.94]	0.140 0.943 0.329 0.523 0.110 0.455 0.044

^a Excluded from multivariable analysis due to small N.

b Age categories classified as; 1) ≥3 years 10 months to <5 years and one month, 2) ≥5 years and one month to <5 years and 10 months (reference category), 3) ≥5 years and 10 months to <6 years 10 months.

Table 5. Risk Factors for Developmental Vulnerability on the Communication Skills & General Knowledge Domain.

Knowledge Domain.						
	DV	NDV	Bivariate		Multivariable	
Characteristic	(N=200)	(N=1,456)			(N=1,352)	
	N (%)	N (%)	OR [95% CI]	p-value	aOR [95% CI]	p-value
Maternal						
Age at Time of Child's B		1				
<25	59 (29.50)	163 (11.20)	13.25 [3.50-50.17]	<0.001	10.96 [2.24-53.75]	0.003
25-29	40 (20.00)	344 (23.63)	1 [referent]	_	1 [referent]	1
30-34	59 (29.50)	547 (37.57)	0.74 [0.24-2.28]	0.602	1.17 [0.33-4.09]	0.811
≥35	42 (21.00)	402 (27.61)	0.75 [0.23-2.47]	0.632	1.34 [0.34-5.26]	0.675
			Overall p-value	<0.001	Overall p-value	0.020
Marital Status	•	1				
Married (inc. de facto)	160 (80.00)	1,320 (90.66)	1 [referent]		1 [referent]	
All Other	40 (20.00)	130 (8.93)	14.40 [2.74-75.72]	0.002	2.28 [0.52-10.04]	0.276
Unavailable	0 (0.00)	6 (0.41)				
Occupational Status Sca		1	1	_		
0-20	68 (34.00)	241 (16.55)	11.20 [3.86-32.50]	<0.001	2.11 [0.67-6.65]	0.203
>20-100	117 (58.50)	1,168 (80.22)	1 [referent]		1 [referent]	
Unavailable	15 (7.50)	47 (3.23)				
Pregnancy & Birth						
Fertility Treatments			1			
No	188 (94.00)	1,200 (82.42)	1 [referent]	_	1 [referent]	1
Yes	12 (6.00)	256 (17.58)	0.10 [0.02-0.39]	<0.001	0.32 [0.06-1.64]	0.172
Smoking Status During I			1			
No	148 (74.00)	1,270 (87.23)	1 [referent]	_	1 [referent]	1
Yes	52 (26.00)	186 (12.77)	7.79 [2.61-23.28]	<0.001	1.51 [0.42-5.45]	0.532
Pre-eclampsia						
No	175 (87.50)	1,285 (88.26)	1 [referent]	_	1 [referent]	
Yes	25 (12.50)	171 (11.74)	1.07 [0.29-3.90]	0.924	0.95 [0.21-4.20]	0.944
Gestational Diabetes						
No	187 (93.50)	1,367 (93.89)	1 [referent]		1 [referent]	
Yes	13 (6.50)	89 (6.11)	1.16 [0.20-6.72]	0.870	1.39 [0.23-8.50]	0.724
Threatened Abortion						
No	192 (96.00)	1,380 (94.78)	1 [referent]		1 [referent]	
Yes	8 (4.00)	76 (5.22)	0.55 [0.09-3.48]	0.524	0.37 [0.02-5.73]	0.477
Other Pregnancy Relate	d Complications	s				
No	51 (25.50)	525 (36.06)	1 [referent]		1 [referent]	
Yes	149 (74.50)	931 (63.94)	2.53 [1.07-6.00]	0.035	1.61 [0.53-4.90]	0.404
Threatened Preterm Lab	oour					
No	178 (89.00)	1,286 (88.32)	1 [referent]		1 [referent]	
Yes	22 (11.00)	170 (11.68)	1.00 [0.27-3.61]	0.994	0.45 [0.11-1.88]	0.272
APH						
No	188 (94.00)	1,410 (96.84)	1 [referent]		1 [referent]	
Yes	12 (6.00)	46 (3.16)	9.09 [0.70-117.63]	0.091	1.15 [0.12-11.44]	0.905
Placenta Praevia a						
No	200 (100.00)	1,446 (99.31)				
Yes	0 (0.00)	10 (0.69)				
Placental Abruption a						
No	199 (99.50)	1,451 (99.66)				
Yes	1 (0.50)	5 (0.34)				
Fetal Distress						
No	172 (86.00)	1,346 (92.45)	1 [referent]		1 [referent]	
Yes	28 (14.00)	110 (7.55)	4.73 [1.00-22.38]	0.050	2.21 [0.52-9.41]	0.285
Cephalopelvic Dispropo	, , , , , , , , , , , , , , , , , , ,			1	,	
No	200 (100.00)	1,452 (99.73)				
Yes	0 (0.00)	4 (0.27)				
	/	. , ,				

No	200 (100)	1,443 (99.11)				
Yes	0 (0.00)	13 (0.89)				
Precipitate Delivery a						
No	195 (97.50)	1,435 (98.56)				
Yes	5 (2.50)	21 (1.44)				
PPH ≥500mls						
No	122 (61.00)	1,077 (73.97)	1 [referent]		1 [referent]	
Yes	78 (39.00)	379 (26.03)	3.72 [1.41-9.86]	0.008	2.38 [0.84-6.74]	0.104
TSR ≥2mins						
No	163 (81.50)	1,261 (86.61)	1 [referent]		1 [referent]	
Yes	37 (18.50)	195 (13.39)	2.80 [1.08-7.22]	0.034	1.55 [0.50-4.86]	0.448
Apgar 5-minutes <7 a						
No	198 (99.00)	1,425 (97.87)				
Yes	2 (1.00)	31 (2.13)				
Intubation						
No	162 (81.00)	1,227 (84.27)	1 [referent]	_	1 [referent]	
Yes	38 (19.00)	229 (15.73)	1.91 [0.80-4.56]	0.147	1.32 [0.45-3.90]	0.614
Early Preterm Birth						
No	157 (78.50)	1,253 (86.06)	1 [referent]	_	1 [referent]	
Yes	43 (21.50)	203 (13.94)	3.73 [0.99-14.09]	0.053	1.68 [0.48-5.82]	0.413
POBW <15 th Percentile		_				
No	146 (73.00)	1,085 (74.52)	1 [referent]	•	1 [referent]	
Yes	36 (18.00)	181 (12.43)	1.83 [0.78-4.33]	0.166	1.77 [0.72-4.32]	0.211
Unavailable	18 (9.00)	190 (13.05)				
Parity						
0	65 (32.50)	597 (41.00)	1 [referent]		1 [referent]	
1	68 (34.00)	515 (35.37)	1.51 [0.59-3.86]	0.385	1.56 [0.38-6.42]	0.536
≥2	67 (33.50)	344 (23.63)	4.54 [1.47-14.09]	0.009	2.48 [0.38-15.95]	0.340
			Overall p-value	0.032	Overall p-value	0.633
Child						
Sex		T			T	
Female	87 (43.50)	763 (52.40)	1 [referent]	1	1 [referent]	
Male	113 (56.50)	693 (47.60)	3.00 [1.56-5.79]	0.001	3.26 [1.49-7.10]	0.003
Ethnicity	T />	T			T	
Other	179 (89.50)	1,393 (95.67)	1 [referent]	1	1 [referent]	
Indigenous Australian	21 (10.50)	63 (4.33)	21.66 [2.34-200.50]	0.007	0.81 [0.10-6.68]	0.842
Child Speaks Language	_	_			1	
No	161 (80.50)	1,355 (93.06)	1 [referent]		1 [referent]	
Yes	39 (19.50)	101 (6.94)	11.16 [3.30-37.77]	<0.001	17.83 [4.10-77.61]	<0.001
Age Category at Time o	· · · · · · · · · · · · · · · · · · ·		T 60 (4 TO 40 00)		0.04.54.07.40.043	
1	57 (28.50)	264 (18.13)	5.60 [1.73-18.09]	0.004	6.01 [1.97-18.31]	0.002
2	125 (62.50)	1,074 (73.76)	1 [referent]	10007	1 [referent]	0.760
3	18 (9.00)	118 (8.10)	1.91 [0.44-8.30]	0.387	1.30 [0.24-6.95]	0.762
Tatal Name base of Cibility			Overall p-value	0.017	Overall p-value	0.007
Total Number of Sibling		450 (24 52)	1 [nofonout]		1 [nofement]	
1	49 (24.50)	459 (31.52)	1 [referent]	0.207	1 [referent]	0.064
3	77 (38.50)	577 (39.63)	1.54 [0.58-4.13]	0.387	0.88 [0.20-3.81]	0.864
>3	37 (18.50)	277 (19.02)	1.64 [0.49-5.44]	0.419	1.11 [0.18-6.78]	0.913
/3	37 (18.50)	143 (9.82)	15.85 [2.91-86.42]	0.001	4.07 [0.48-34.47]	0.198
Sociodemographic			Overall p-value	0.015	Overall p-value	0.371
Sociodemographic Index of Relative Socioe	conomic Disad	vantage				
		_	A 2A [1 12 16 02]	0 033	0 02 [0 26 2 26]	0.000
Lowest Quintile	153 (76.50)	1,220 (83.79)	4.24 [1.12-16.03] 1 [referent]	0.033	0.92 [0.26-3.26] 1 [referent]	0.890
> Lowest Quintile Unavailable	42 (21.00) 5 (2.50)	195 (13.39) 41 (2.82)	1 [referent]		1 [referent]	
Ullavaliable	5 (2.50) iable analysis du					

a Excluded from multivariable analysis due to small N.

b Age categories classified as; 1) ≥3 years 10 months to <5 years and one month, 2) ≥5 years and one month to <5 years and 10 months (reference category), 3) ≥5 years and 10 months to <6 years 10 months.

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of cohort studies

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	3
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5-6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	3
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	3 and 7
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	7
		(b) For matched studies, give matching criteria and number of exposed and unexposed	n/a
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-10
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-10
Bias	9	Describe any efforts to address potential sources of bias	6-10
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7-10
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	10
		(b) Describe any methods used to examine subgroups and interactions	10
		(c) Explain how missing data were addressed	10
		(d) If applicable, explain how loss to follow-up was addressed	10
		(e) Describe any sensitivity analyses	10
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed	7-11
		eligible, included in the study, completing follow-up, and analysed	
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	N/A
Descriptive data 14*		(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	10-11 and 26-29
		(b) Indicate number of participants with missing data for each variable of interest	26-31
		(c) Summarise follow-up time (eg, average and total amount)	N/A
Outcome data	15*	Report numbers of outcome events or summary measures over time	26-29
Main results 1	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence	10-11 and 26-29
		interval). Make clear which confounders were adjusted for and why they were included	
		(b) Report category boundaries when continuous variables were categorized	10-11
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	11
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	
Generalisability	21	Discuss the generalisability (external validity) of the study results	15
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	17

^{*}Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.