Maternal Exposure to Violence and Offspring Neurodevelopment: A Systematic Review

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SOCIAL MEDIA QUOTE

Systematic review finds evidence for developmental problems, especially externalising behaviours, in children born to mothers exposed to domestic violence during the pregnancy.

SYNOPSIS

Study question

Does exposure to domestic violence during pregnancy lead to neurodevelopmental difficulties in the offspring?

What is already known

There is a high global prevalence of violence against women with prevalence rates for intimate partner violence during pregnancy estimated at between 2-13%. Psychological stress and anxiety during pregnancy have been associated with developmental difficulties in the offspring.

What this study adds

This study addresses the need for a summary of the evidence that links violence during pregnancy, as an extreme stressor, and developmental difficulties in the offspring.

KEY WORDS

Violence; intimate partner violence; domestic violence; neurodevelopment; prenatal; impaired development; maternal stress; mental health

WORD COUNT:

Abstract – 298

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ABSTRACT

Background: Stress during pregnancy is known to affect foetal neurodevelopment. It seems likely therefore, that intimate partner violence (IPV) and domestic violence (DV), as extreme stressors will have a similarly adverse effect.

Objectives: A systematic review was conducted to assess the association between prenatal exposure to violence for mothers and developmental difficulties in their children.

Data Sources: PubMed, PsycInfo, CINAHL, ERIC, Science Direct, SCOPUS, PsyARTICLES, Networked Digital Library of Theses and Dissertations, Women's Studies International and Gender Studies Database were all searched using the agreed search terms.

Study Selection and Data Extraction: We include studies of women who have experienced any violence, fear of violence or aggression while pregnant, including emotional, psychological, physical or sexual violence in the context of IPV or DV. Studies were excluded if the neurodevelopmental outcomes of the offspring were not assessed. Studies from all countries were included, in English or translated to English, and search dates were not restricted. We included all years from inception of the database until the search date.

Synthesis: Study design and biases, assessment tools, management of confounding, results and overall quality were assessed.

Results: We identified 11 papers reporting on observational studies. Almost three quarters of the studies found a relationship between prenatal exposure to violence and developmental difficulties in the offspring. Differing assessment tools were used with a range of data collected and not all adjusted their findings for the same confounders.

Conclusions: Current evidence on the relationship between prenatal violence exposure, as IPV or DV, and consequent child developmental disorders remains limited. Future research using comprehensive study designs, larger samples and longitudinal follow-up of the

offspring could clarify this association. While maternal trauma resulting from exposure to violence may play an important role in childhood development disorders, additional intervening factors on the pathway need further explored.

BACKGROUND

Universally, women are exposed to conflict and various forms of violence including domestic violence (DV), torture and rape. Moreover, maternal stress appears to be associated with problems in infant development suggesting that exposure to violence during pregnancy may also be related to neurodevelopmental difficulties.[1,2] Foetal development is rapid in the womb so the intensity and timing of stress could have distinct effects on this process.[3] This systematic review examines the evidence that the offspring of women exposed to violence during pregnancy are at increased risk of adverse neurodevelopmental outcomes.

Domestic violence has been shown to affect pregnant women's mental health, seen when measuring psychiatric disorders in those abused.[4,5] Domestic violence has also been associated with high levels of perceived stress in a study of factors influencing a group of multi-ethnic inner-city women in Canada.[6] Stress during pregnancy has been linked to autism and attention deficit hyperactivity disorder (ADHD) in several studies[7,8] and to general neurodevelopmental difficulties.[9] Stress, possibly by the effect of cortisol exposure, has an epigenetic effect on foetal development that may adversely affect the development of the brain.[10]

In 2011 the World Health Organisation (WHO) declared violence against women as an urgent public health priority as it appears to be on the rise.[1] The possible relationship between violence against women and child neurodevelopmental difficulties adds to this urgency. However, there is limited research into the risk for adverse neurodevelopmental outcomes and studies examine different behavioural and biological indicators creating a complex picture.

A small body of research has examined either domestic violence (DV) or intimate personal violence (IPV) during pregnancy in relation to neurodevelopmental outcomes.[11,12] Intimate partner or domestic violence is commonplace globally,[13] an exposure more common than some other maternal health conditions more routinely checked for in prenatal screenings[14] and is highly prevalent across both developed and developing countries, across ethnic groups and thought to be particularly common during pregnancy.[15,16] There is some evidence that ethnicity may play a role in how the placenta reacts to stress and therefore how this affects the developing foetus: for example, stress-related expression of the placental genes that regulate cortisol in the placenta was found in Caucasian women only.[17] Developing countries have the highest rates of DV, especially those in Africa.[15,18] This could be due to civil conflict as the 40% of countries in Sub Saharan Africa that have seen conflict have significantly higher rates of DV.[19] Sexual abuse is used as a tool of war in some conflicts, for example in the Democratic Republic of Congo (DRC), and this may create a desensitisation in the society towards abuse of women.

Several studies identify characteristics of women at risk for IPV or DV in developed countries. For example, among a population of 33,000 ethnically diverse pregnant women in Australia, high rates of DV were found for mothers having subsequent pregnancies and those with a history of childhood abuse.[16] Childhood abuse has emerged as a risk factor in other studies and has been determined to be a predictor of neurodevelopmental difficulties in offspring.[20,21]

The effects of IPV on the mother are well studied. Mental health problems, substance abuse, poor nutrition, chronic pain and inadequate prenatal care are common.[22] Documented neonatal outcomes include babies born preterm, of low birthweight and small for gestational age.[23] There is also a higher risk for miscarriage, neonatal death and maternal death, specifically by homicide or IPV-related suicide.[24] However, effects on the longer term development of the offspring are not well understood.

There are considerable methodological challenges in understanding this relationship. Isolating the exposure from the outcome is complex and may lead to a variety of methods to manage confounding and surrounding factors. Prenatal factors that are associated with neurodevelopmental difficulties include poor maternal mental health,[25,26] illness or substance use[27,28] and birth outcomes such as preterm or low birthweight.[29,30] These need to be considered along with some post-birth risks such as continued IPV,[31] postnatal depression[32] and possibly aspects of feeding[33] and parenting.[34]

The studies also may differ as to which neurodevelopmental disorders or related symptoms are examined as development is complex and there are a variety of indicators. Developmental domains can include internalising and externalising behaviours and motor, language or cognitive delays.[35]

We undertook a systematic review in order to assess the evidence on the relationship between exposure to violence, as IPV or DV, during pregnancy and the neurodevelopment of the offspring, as measured by externalising and internalising behaviours, and cognitive, motor and language delays. The World Health Organisation definition of IPV is used: any physical, sexual or psychological harm inflicted by a current or former intimate partner.[36] DV

is the same as for an intimate partner, but can also include similar abuse by another close family member.

METHODS

Data Sources

This review follows the PRISMA guidelines and the protocol is registered on PROSPERO Database of Systematic Reviews. One reviewer (KT) conducted the searches, removed duplicate studies and identified further studies through reference list mining and review of other research by relevant authors. PubMed, PsycInfo, CINAHL, ERIC, Science Direct, SCOPUS, PsyARTICLES, Networked Digital Library of Theses and Dissertations, Women's Studies International and Gender Studies Database were all searched using the agreed search terms and following the PICO framework. For example, the search on PubMed was run as follows:

Population/ Controls - **natal OR maternal OR gestation* OR pregnan* OR mother OR offspring* AND Indicator (exposure) - *"armed conflict" OR war OR "war trauma" OR refugee OR genocide OR "community violence" OR "ethnic cleansing" OR "political violence" OR "asylum seeker" OR "displaced people" OR "domestic violence" OR violence OR "gun violence" OR "inner city" OR "drug war" OR rape OR "intimate partner violence" OR IPV OR sectarian OR PTSD OR trauma OR abuse;* AND Outcome - *neurodevelopment OR ASD OR auti* OR ADHD OR "attention deficit" OR tourette OR stutter* OR "intellectual disability" OR "learning disability" OR externaliz* OR externalis**

Inclusion criteria

We include studies of women who have experienced any violence, fear of violence or aggression while pregnant, including emotional, psychological, physical or sexual violence in the context of IPV or DV. Studies were excluded if the neurodevelopmental outcomes of the offspring were not assessed. Studies from all countries were included if papers were in English or had been translated to English and search dates were not restricted. We included all years from inception of the database until the search date. The first search was conducted on 14/1/19 and a follow up search on 14/6/19 revealed one more paper published in 2019.[37]

Study Selection

RefWorks was used to store information on the selected studies. Initially these were screened by title and abstract. This initial list was then re-examined by reading the full paper and considering inclusion and exclusion criteria. Each study design was assessed by examining the features described in the published paper and only those studies that broadly met the inclusion/exclusion criteria were considered for review by a second reviewer (GL). Both reviewers then independently assessed the selected papers and agreed on the final eleven. As we were also interested in factors such as whether violence had been experienced before pregnancy or after birth, the population of interest in the study, chosen confounders, exposure and outcome measures and the cultural context of the study, the tables have been drawn up to reflect this (see Tables 1-3). As each study has a different approach to these factors separating these influences can be complex. Confounders for developmental outcomes often include some combination of socio-demographics, mental health, birth outcomes, gestational risks and postnatal risks. Additionally, exposure to violence and offspring development can be measured by a variety of instruments.

We excluded one further study that examined war violence as the exposure.[38] This was the only study of its kind found – in itself identifying a gap in the literature. However, as the remaining selected papers all consider IPV or DV, it was decided to restrict the exposure to these forms of violence only.

Data extraction

The full text was obtained for all studies that met the inclusion criteria. Data was extracted using a standardised extraction form and the information input was agreed by both reviewers.

Data items collected

The data extraction form completed for each study recorded: study purpose; relevance of the literature review and rationale for study; study location, design and appropriateness; sample description, size and ethics procedures; outcomes measured and reliability and validity of measures used; exposures measured, reliability and validity again considered, and confounders; results and statistical significance; limitations and potential biases; and conclusions and implications.

Assessment of exposure

The type and severity of the exposure is important, so the method of data collection was considered and the training of persons collecting the data as many times this is through interview or questionnaire. As IPV or DV is sensitive information and may be affected by cultural perspectives, the reviewers assessed how studies have managed collecting this data and which instruments were used.

Assessment of outcome

Infant development is measured by domains which include physical, social, emotional, cognitive and speech and language development. Having a well-established and culturally appropriate instrument is important. In this review the domains examined range from socio-emotional, such as internalising or externalising behaviours, to cognitive, speech and motor as indicators of difficulty. Reviewers assessed the age at which the child was tested, the instruments used and the training of persons collecting the data.

RESULTS

Study Characteristics

We found eleven papers reporting on studies which fit the criteria. These investigate domestic violence or intimate partner violence during pregnancy (n=11)[11,12,37,39-46] and most also measure IPV before or after pregnancy (n=7).[11,12,40,42-45] Offspring developmental outcomes are measured between six months and eighteen years of age. These mostly assessed for externalizing and internalizing behaviours and infant development and only one[42] assessed for a developmental disorder, autism.

Sample size

With the exception of the study assessing autism (n=54,761),[42] sample sizes were generally small (range 22-682 dyads, mean=218). In ten studies the sex of the offspring was given, 49.8% were males and 50.2% females. These small sample sizes are of concern for possible false discovery rate and low statistical power.[47]

Socio-demographic characteristics

The studies recruited from both developing and developed countries with Nicaragua,[40] South Africa (n=2),[12,46] China,[41] Canada,[39] and the USA (n=6)[11,37,42-45] represented. Samples were urban, peri-urban or rural. The autism study recruited from a wider population range and included several States of the US. The mothers' ages varied between fourteen and forty-four but no breakdowns were reported.

Nine studies gave the ethnic breakdown of the participating mothers and with the large study on autism being included, the majority were white (93.74%). Excluding this study, there was a more detailed breakdown of ethnicity showing a fairly wide range. In the other studies, excluding the large autism study[42] and one in South Africa[12] that did not give an ethnic breakdown of participants, the results were as follows: 39% Black (n=654), 21% Hispanic or Latino (n=358), 18% White (n=307), 13% Asian (n=230), 8% bi-racial or multi-racial (n=130) and 1% identified as Native American (n=13).

Study designs

All studies were observational, eight were cohort studies[11,12,37,40-42,46] and three were case control studies.[39,43,45] Four studies recruited from larger existing studies,[12,40,42,46] four used fliers and advertising in the community,[11,39,43,44] two recruited from local health care centres [37,41] and one approached safe shelters and a District Attorney's office.[45]

Assessment tools

Exposure to violence

Exposure to violence was assessed using questionnaires or interviews (Table 2). Nine different standard instruments were used in various combinations making comparison difficult. Basically, exposure to violence was established but other variables such as intensity or timing could not be compared. The Severity of Violence Against Women Scale (SVAWS)[48] was used in three studies and the Abuse Assessment Screen (AAS)[49] was used in a different three studies. Both have good psychometric properties.[50,51]

Two studies used their own self-designed questionnaires. One recruited from safe shelters and established exposure to IPV using five questions.[45] Another study used only one question: "Has anyone hit you or physically hurt you in the past year?"[37] Questions like this that ask for clear, observable behaviours are shown to have good specificity and sensitivity in assessing abuse.[52]

Maternal mental health

Seven studies collected data on maternal mental health.[11,40-44,46] Depression, anxiety, PTSD and emotional distress were measured using seven different instruments. Most included the Beck Depression Inventory (BDI),[53] the Edinburgh Postnatal Depression Rating Scale (EPDS),[54] the Self-Reporting Questionnaire (SRQ-20)[55] and/or the PTSD Symptom Scale.[56]

Developmental outcomes

Developmental outcomes in children can be measured in different ways; various questionnaires and scales have been created. The most common instruments used in these studies were the Child Behaviour Checklist (CBCL)[57] and the Bayley Scales for Infant and Toddler Development (BSID III).[58] Both have well established multicultural reliability and

validity.[59,60] Other measures used also have acceptable psychometrics: the Infant Social and Emotional Assessment (n=3),[61] the 80 item Parent Rating Scale – Revised:Long Form (n=1),[62] and the Chinese version of the Revised Infant Temperament Questionnaire (n=1).[63]

Confounding variables

Confounding was an important factor to be considered and is a major concern in observational studies. Five main areas were addressed in most of the studies: socio-demographics, maternal mental health, adverse birth outcomes, gestational risks and pre-pregnancy and/or post-birth risks (see Table 3). All studies included some measure of socio-economic status, most gave the ethnic breakdown of the participants and six considered marital status. Maternal mental health, as in depression and anxiety, are shown to be risks and all but four studies[12,37,39,45] adjusted for these. Birth outcomes and gestational illnesses or substance use were addressed by most studies (n=8). Only two studies gave no information on maternal mental health, birth outcomes or gestational risk factors.[12,37] The last category considered by most of the studies (n=10) was risk factors from around the pregnancy period, for example parenting style, postnatal depression or exposure to violence after birth.

Quality assessment

The Newcastle-Ottawa quality assessment scale was used to score the quality of the studies. This scale assesses possible bias in the design and conduct of non-randomised studies.[64] All the cohort studies were found to be of a fair quality. Sample sizes were small in all the studies so sampling error was potentially a problem. The case-control studies were found to be of poor to fair quality. This was mainly for two reasons: observer bias was not adequately

addressed; and recall bias may be present as assessments were by self-report or questionnaire.

Eight studies used specially trained university students, professionals or researchers to carry out the assessments, while one was a questionnaire filled out by the mother and mailed to the researchers[39] and two had no information on the assessors.[37,45] Instruments had been translated into relevant languages and all non-English speaking studies had considered the validity of these in multicultural contexts. Three studies in the United States only included English speakers which could have introduced bias.[11,43,44]

Cultural considerations were addressed in some form by four of the five studies that took place in non-Western populations. Two of these discussed cultural impact on study design[40,46] and two discussed impact on choice of assessment instruments.[12,41] The Canadian study that engaged a majority of Aborigine mothers mentioned only that culture may have impacted on their results but without explanation.[39]

A strong association between exposure to violence during pregnancy and impaired neurodevelopment in the offspring was found in eight studies[11,37,39,41,43-46] (see Table 4 for effect sizes). These all found an association with externalising symptoms, and four also found for internalising symptoms, but this association was weaker. One study[42] found that abuse in the two years before the year of birth is associated with autism. This indicates that the longer-term effects of abuse on the mother's mental health may be more important in this relationship.

Three studies[12,40,42] found no direct association between pregnancy exposure to violence and impaired child neurodevelopment. In one there was a significant link between prenatal cortisol levels and externalising behaviours in the offspring but not directly with prenatal abuse.[40] Other findings included two studies that found abuse during pregnancy predicted postnatal abuse[44,45] and three found that it predicted maternal distress.[37,41,44] Both of these factors may also play a role in impaired infant development.

COMMENT

Principal findings

Although the evidence is somewhat limited, the putative association between exposure to violence and impaired development remains a possibility. The studies are all fairly recent and build on the hypothesis that excessive prenatal stress has a detrimental effect on offspring, requiring more investigation. Publication bias is an acknowledged limitation of any systematic review as only about half of all completed research projects reach publication and those that do are more likely to be those showing a significant result rather than null findings.[65]

Strengths of the study

In seeking to include all knowledge on the effects of prenatal IPV or DV on offspring development this review provides more reliable evidence of an association than the results of each individual study. This is an important question for practice and policy as the association is not immediately obvious but the implications are far reaching. This review allows for this evidence to be more accessible. Although sample sizes are generally small, the studies represent a wide range of ethnicities and include several countries (representing

all socioeconomic strata) so bias from cultural perspectives of IPV are reduced. The challenges identified by the studies allow for knowledge gaps on study design and conduct to be addressed so that future studies are likely to provide increasingly reliable evidence.

Limitations of the review

First, different study designs and methodologies were used making direct comparison difficult. For example, one of the studies is cross sectional and may not provide evidence of association as rigorous as those of longitudinal studies. Selection bias is a concern as studies were mostly small and some recruited using advertisements in the community. Those who volunteer for studies are not generally representative of the population, especially when the exposure carries a stigma. [66] IPV may be shameful to report and women may feel there will be consequences to doing so and therefore be reluctant participants. This may be a problem driving selection and response bias for all the studies.

Second, different indices are used in measuring outcomes. They measure slightly differing developmental domains across a range of eighteen years, so can only serve as indicators that some aspects of development are impaired from prenatal violence exposure. Further studies are needed in order to more fully understand this apparent association.

Cultural differences present factors that can complicate the generalisability and comparability of studies. For example, child development can be ethnically influenced. One study pointed out that research acknowledges the advanced motor development of African children over other ethnicities.[12] This then affects aspects of the reliability and use of child development scales in Africa that have been designed for assessing western populations and

may indicate that the unadjusted findings by Koen et al.,[46] the other African population studied in this review, may be more meaningful.

Third, a difficulty faced by most of the studies was how to isolate the pregnancy period to determine if reported exposures were exclusively the source of developmental problems. IPV or exposure to violence may continue after birth or have been a long-term stressor from before the pregnancy. As childhood abuse appears to be a predictor of IPV in later relationships, there is a vulnerability to abuse that may in itself present other conditions during pregnancy that may be related to outcomes. For example, an emotionally vulnerable mother may have difficulty with self-care and lack initiative to make medical appointments, eat a healthy diet or take steps towards protecting the pregnancy.[67] This may be more so for a first pregnancy as subsequent pregnancies may benefit from a mother's experience of having a child and prioritizing their care.

Another difficulty in connecting pregnancy events with neurodevelopmental outcomes concerns the temporal relationship between exposure and disease outcome. Adverse exposures after birth and difficulties in the attachment experience of the baby and mother have also been associated with developmental disorders and, if not causal, may be related to symptom severity. Some of the studies considered these and measured the babies' own exposure to DV or postnatal depression in the mother (as this can affect attachment) and accounted for these in the analysis. One study which measured offspring symptoms and HPA axis activation (through cortisol levels) at age nine queried whether foetal programming may fade over time.[40] Another study where outcome measures were taken at ten months also queried a temporary association.[41] There is a body of research that finds

associations between postnatal stressors and child developmental difficulties but many of these do not consider the prenatal period and may possibly overestimate the independent effects of these postnatal exposures.[43]

Fourth, in these studies there are a smaller numbers of physical abuse victims, as compared to psychological and sexual abuse.[41,42] There is a possibility that experiencing physical violence may lead to more miscarriages or stillbirths and so the effect on the foetus cannot be measured and may be underestimated. One study only addressed physical violence and found that the child exhibited more aggression, but only towards the mother. This suggests other factors are involved such as attachment or the mother's emotional capacity for parenting during or after physical abuse.[37]

Studies have used different methods to try and control for these surrounding factors, such as excluding mother/child dyads with other risk factors for adverse neurodevelopmental outcomes.[41] For example, excluding low birthweight or preterm babies, mothers who used tobacco or alcohol while pregnant or those mothers who also experienced IPV outside of the pregnancy period. Other studies measured common risk factors such as depression or gestational illnesses for the mother and adjusted for these in their analysis. There are a myriad of other possible factors that could affect a foetus or newborn child and the inability to include all of these was a limitation for all the studies.

Interpretation

A mother's mental health may to be a noteworthy factor in the effects of exposure to violence and extreme stress and developmental outcomes for the offspring.[31] The mother's

mental health has been associated with neurodevelopmental disorders in the offspring and studies show that depression is understandably common for women who have been exposed to violence.[68] In one study which examined developmental outcomes for war exposed women, pre- and postnatal depression mediated the effects of trauma on the infants so that the resulting association became no longer significant.[38] A mother's mental health appears to be protective when facing trauma.

Most studies adjusted for depression and PTSD, although these may have different effects. Understanding the physiological development of PTSD also raises the question of whether a mother's physiological reaction to violence and trauma is different from a mother's physiological reaction to the build up of less severe stressors over time. However, PTSD may be a measure of accumulative effects of exposure to violence and abuse that may affect pregnancy.[42] Other studies have shown that children of mothers who have developed PTSD from IPV have a higher risk for behaviour problems than those whose mothers did not develop PTSD.[69]

If maternal stress during pregnancy is a causal factor in the aetiology of neurodevelopmental difficulties then exposure to violence, existing PTSD, anxiety disorders and other non-violence related stressors may all contribute in a similar way. The question may be one of intensity, endurance or timing of the stress reaction.[3,70] A few studies included a salivary cortisol test that may be a more composite measure of total stress load than trying to track the nature of events.

Studies that included measures of salivary cortisol or cord blood cortisol levels had interesting findings. One study found that the HPA axis reactivity and behavioural functioning were not related so may be functionally different aspects of a child's capacity to adapt to the environment in early development.[43] Another found a similar result as cortisol hyperactivity was not associated with child reported internalizing or externalizing behaviours and cortisol secretion was not related to child externalizing behaviours.[44] The possibility was raised that the detrimental influence of prenatal IPV may override temperamental or biological susceptibility to externalizing behaviour, and increase risk in spite of the infant stress response patterns. Isaksson[40] found an association between maternal cortisol levels and behaviours, but not child cortisol levels, so also questioned the mechanism that underlies this connection, although there may be reliability problems with this study in regard to saliva collection.

The review findings align with the intergenerational conceptual model[31] where exposure to violence is the beginning of a pathway to higher risk with other factors, such as maternal mental health, influencing the level of risk as time passes. Research that isolates the pregnancy period as having risks specific to very early foetal brain development may add another dimension to this hypothesis that may have implications for causal mechanisms.

CONCLUSIONS

Violence experienced by a mother as IPV or DV during pregnancy may be associated with poorer developmental outcomes, especially as externalising behaviours, in the offspring. However, the findings are inconclusive and more evidence is needed to understand the

physiology of how maternal IPV may affect the offspring, and the mediating effects of depression and other mental health problems.

IMPLICATIONS

There is a need for interventions to alleviate stress for pregnant women in war zones, refugee camps or third country placement. The possibility of an increase in IPV after conflict and the already fairly high global prevalence rates put many babies at possible risk globally. Current evidence is limited by the design and conduct of these studies. There is a need for well designed and adequately powered studies with longer follow up of the offspring, optimally into adolescence. The use of similar instruments in studies would be helpful for comparison of results. Replication is needed for the couple of studies that included laboratory testing of stress hormones. Other mechanisms also need tested as studies have found that the effect of increased cortisol is not the only underlying mechanism between stress and neurodevelopment.[71]

Clinical implications agree with a growing body of research that recommends addressing prenatal IPV and the mental health needs of pregnant women and incorporating this into routine perinatal care. Somehow involving the father or mother's partner in routine prenatal care where possible and addressing family systems seems vital in order to holistically address prenatal IPV. It makes social and economic sense and could have a large impact on future generations to invest heavily in the mother's care for this relatively short time period if this is crucial to the future developmental course of the child's lifetime.

References

1. Garcia-Moreno C, Watts C. Violence against women: An urgent public health priority. 2011; 89(1), Article 2.
2. Buffa G, Dahan S, Sinclair I, St-Pierre M, Roofigari N, Mutran D et al. Prenatal stress and child development: A scoping review of research in low- and middle-income countries. *PLOS ONE* 2018; 13:e0207235.
3. Bronson SL, Bale TL. The Placenta as a Mediator of Stress Effects on Neurodevelopmental Reprogramming. *Neuropsychopharmacology: Official Publication Of The American College Of Neuropsychopharmacology* 2016; 41:207-218.
4. Golding JM. Intimate Partner Violence as a Risk Factor for Mental Disorders: A Meta-Analysis. *Journal of Family Violence* 1999; 14:99-132.
5. Howard LM, Trevillion K, Khalifeh H, Woodall A, Agnew-Davies R, Feder G. Domestic violence and severe psychiatric disorders: prevalence and interventions. *Psychological Medicine* 2010; 40:881-893.
6. Rieger KL, Heaman MI. Factors Associated With High Levels of Perceived Prenatal Stress Among Inner-City Women. *Journal of Obstetric, Gynecologic & Neonatal Nursing* 2016; 45:180-195.
7. Ronald A, Pennell C, Whitehouse A. Prenatal Maternal Stress Associated with ADHD and Autistic Traits in early Childhood. *Frontiers in Psychology* 2011; 1:223.
8. Ward AJ. A comparison and analysis of the presence of family problems during pregnancy of mothers of “autistic” children and mothers of typically developing children. *Child Psychology and Human Development* 1990; 20:279-288.

9. O'Donnell K, O'Connor,T.G., Glover V. Prenatal stress and neurodevelopment of the child: focus on the HPA axis and role of the placenta. *Developmental Neuroscience* 2009; 31:285-292.
10. Grayson D, Guidotti A. Merging data from genetic and epigenetic approaches to better understand autistic spectrum disorder. *Epigenomics* 2016; 8:85-104.
11. Martinez-Torteya C, Bogat GA, Lonstein JS, Levendosky AA, Granger, DA. Exposure to intimate partner violence in utero and infant internalizing behaviors: Moderation by salivary cortisol-alpha amylase asymmetry. *Early Human Development* 2017; 113:40-48.
12. Rodriguez VJ, Peltzer K, Matseke G, Weiss SM, Shine A, Jones DL. Pre- and postnatal exposure to intimate partner violence among South African HIV-infected mothers and infant developmental functioning at 12 months of age. *Archives of Womens Mental Health* 2018; 21:707-713.
13. Devries KM, Mak JYT, Garcia-Moreno C, Petzold M, Child JC, Falder G et al. The Global Prevalence of Intimate Partner Violence Against Women. *Science* 2013; 340:1527-1528.
14. Devries KM, Kishor S, Johnson H, Stöckl H, Bacchus LJ, Garcia-Moreno C et al. Intimate partner violence during pregnancy: analysis of prevalence data from 19 countries. *Reproductive Health Matters* 2010; 18:158-170.
15. Shamu S, Abrahams N, Temmerman M, Musekiwa A, Zarowsky C. A systematic review of African studies on intimate partner violence against pregnant women: prevalence and risk factors. *PLoS ONE.* 2011; 6:e17591.
16. Dahlen HG, Munoz AM, Schmied V, Thornton C. The relationship between intimate partner violence reported at the first antenatal booking visit and obstetric and

perinatal outcomes in an ethnically diverse group of Australian pregnant women: a population-based study over 10 years. *BMJ OPEN* 2018; 8:e019566.

17. Capron L, Ramchandani P, Glover V. Maternal prenatal stress and placental gene expression of NR3C1 and HSD11B2: The effects of maternal ethnicity. *Psychoneuroendocrinology* 2018; 87:166-172.
18. Cervantes-Sánchez P, Delgado-Quiñones EG, Nuño-Donlucas MO, Sahagún-Cuevas MN, Hernández-Calderón J, Ramírez-Ramos JK. Prevalence of domestic violence in pregnant women from 20 to 35 years in a family medicine unit. *Revista Medica del Instituto Mexicano del Seguro Social* 2016; 54:286-291.
19. Elbadawi E, Sambanis N. Why are there so many civil wars in Africa? Understanding and preventing violent conflict. *Journal of African Economies* 2000; 9:244-269.
20. Roberts AL, Lyall K, Ascherio A, Weisskopf MG, Rich-Edwards J. Association of maternal exposure to childhood abuse with elevated risk for autism in offspring. *JAMA Psychiatry* 2013; 70:508-515.
21. Roberts AL, Koenen KC, Lyall K, Ascherio A, Weisskopf MG. Women's posttraumatic stress symptoms and autism spectrum disorder in their children. *Research in Autism Spectrum Disorders* 2014; 8:608-616.
22. Alhusen JL, Ray E, Sharps P, Bullock L. Intimate Partner Violence during Pregnancy: Maternal and Neonatal outcomes. *Journal of Women's Health* 2015; 24:100-106.
23. Berhanie E, Gebregziabher D, Berihu H, Gerezgiher A, Kidane G. Intimate partner violence during pregnancy and adverse birth outcomes: a case-control study. *Reproductive Health* 2019; 16:22.

24. Palladino CL, Singh V, Campbell J, Flynn H, Gold KJ. Homicide and suicide during the perinatal period: Findings from the national violent death reporting system. *Obstetrics and Gynecology* 2011; 118:1056-1063.

25. Mughal MK, Giallo R, Arnold P, Benzies K, Kehler H, Bright K et al. Trajectories of maternal stress and anxiety from pregnancy to three years and child development at 3 years of age: Findings from the All Our Families (AOF) pregnancy cohort. *Journal of Affective Disorders* 2018; 234:318-326.

26. Field T. Prenatal anxiety effects: A review. *Infant Behavior & Development* 2017; 49:120-128.

27. Kiechl-Kohlendorfer U, Ralser E, Pupp Peglow U, Reiter G, Griesmaier E, Trawöger R. Smoking in pregnancy: a risk factor for adverse neurodevelopmental outcome in preterm infants? *Acta Paediatrica* 2010; 99:1016-1019.

28. Landgren M, Svensson L, Strömland K, Andersson Grönlund M. Prenatal alcohol exposure and neurodevelopmental disorders in children adopted from Eastern Europe. *Pediatrics* 2010; 125:e1178-e1185.

29. Boulet SL, Schieve LA, Boyle CA. Birth Weight and Health and Developmental Outcomes in US Children, 1997–2005. *Maternal & Child Health Journal* 2011; 15:836-844.

30. Potijk MR, Kerstjens JM, Bos AF, Reijneveld SA, de Winter AF. Developmental Delay in Moderately Preterm-Born Children with Low Socioeconomic Status: Risks Multiply. *The Journal of Pediatrics* 2013; 163:1289-1295.

31. Symes L, McFarlane J, Maddoux J, Fredland N. Evaluating an Intergenerational Model to Explain the Path From Violence Against Mothers to Child Behavior and Academic Outcomes. *Violence Against Women* 2019.

32. Prenoveau JM, West V, Giannakakis A, Zioga M, Lehtonen A, Davies B et al. Maternal Postnatal Depression and Anxiety and Their Association With Child Emotional Negativity and Behavior Problems at Two Years. *Developmental Psychology* 2017; 53:50-62.
33. Iacovou M, Sevilla A. Infant feeding: the effects of scheduled vs. on-demand feeding on mothers' wellbeing and children's cognitive development. *European Journal of Public Health* 2013; 23:13-19.
34. Levendosky AA, Leahy KL, Bogat GA, Davidson WS, von Eye A. Domestic violence, maternal parenting, maternal mental health, and infant externalizing behavior. *Journal of Family Psychology* 2006; 20:544-552.
35. Boggs D, Milner KM, Chandna J, Black M, Cavallera V, Dua T et al. Rating early child development outcome measurement tools for routine health programme use. *Archives of Disease in Childhood* 2019; 104:S22-S33.
36. World Health Organization/ London School of Hygiene and Tropical Medicine. Preventing intimate partner and sexual violence against women: taking action and generating evidence. 2010.
37. Miller-Graff L, Nuttall AK, Lefever JEB. Interpersonal violence during pregnancy: Enduring effects in the post-partum period and implications for the intergenerational transmission of risk. *International Journal of Behavioral Development* 2019; 43:195-203.
38. Punamaki RL, Diab SY, Isosavi S, Kuittinen S, Qouta SR. Maternal Pre- and Postnatal Mental Health and Infant Development in War Conditions: The Gaza Infant Study. *Psychological Trauma: Theory, Research, Practice, and Policy* 2018; 10:144-153.

39. Tan JCH, Gregor KV. Violence against Pregnant Women in Northwestern Ontario. *Annals of the New York Academy of Sciences* 2006; 1087:320-338.

40. Isaksson J, Lindblad F, Valladares E, Högberg U. High maternal cortisol levels during pregnancy are associated with more psychiatric symptoms in offspring at age of nine – A prospective study from Nicaragua. *Journal of Psychiatric Research* 2015; 71:97-102.

41. Zou S, Zhang Y, Cao Y, Zhang Y. Correlation of maternal abuse during pregnancy with infant temperament and development. *Archives of Disease in Childhood* 2015; 100:938-943.

42. Roberts A, Lyall K, Rich-Edwards J, Ascherio A, Weiskopf M. Maternal exposure to intimate partner abuse before birth is associated with autism spectrum disorder in offspring. *Autism* 2016; 20:26-36.

43. Levendosky AA, Bogat GA, Lonstein JS, Martinez-Torteya C, Muzik M, Granger DA et al. Infant adrenocortical reactivity and behavioral functioning: relation to early exposure to maternal intimate partner violence. *Stress-The International Journal on the Biology of Stress* 2016; 19:37-44.

44. Martinez-Torteya C, Bogat GA, Levendosky AA, von Eye A. The influence of prenatal intimate partner violence exposure on hypothalamic-pituitary-adrenal axis reactivity and childhood internalizing and externalizing symptoms. *Development and Psychopathology* 2016; 28:55-72.

45. Bianchi AL, McFarlane J, Cesario S, Symes L, Maddoux J. Continued Intimate Partner Violence During Pregnancy and After Birth and Its Effect on Child Functioning. *Journal of Obstetric Gynecologic and Neonatal Nursing* 2016; 45:601-609.

46. Koen N, Brittain K, Donald KA, Barnett W, Koopowitz S, Mare K et al. Maternal posttraumatic stress disorder and infant developmental outcomes in a South African

birth cohort study. *Psychological Trauma: Theory, Research, Practice, and Policy* 2017; 9:292-300.

47. Colquhoun D. An investigation of the false discovery rate and the misinterpretation of p-values. *Royal Society Open Science* 2014; 1:140216.
48. Marshall LL. Development of the severity of violence against women scales. *Journal of Family Violence* 1992; 7:103-121.
49. McFarlane J, Parker B, Soeken K. Abuse during pregnancy: frequency, severity, perpetrator, and risk factors of homicide. *Public Health Nursing* 1995; 12:284-289.
50. Thompson MP, Basile KC, Hertz MF, Sitterle D. Measuring Intimate Partner Violence Victimization and Perpetration: A Compendium of Assessment Tools. *Centers for Disease Control and Prevention*. Atlanta, GA, 2006.
51. Arkins B, Begley C, Higgins A. Measures for screening for intimate partner violence: a systematic review. *Journal of Psychiatric and Mental Health Nursing* 2016; 23:217-235.
52. Sohal H, Eldridge S, Feder G. The sensitivity and specificity of four questions (HARK) to identify intimate partner violence: A diagnostic accuracy study in general practice. *BMC Family Practice* 2007; 8:49.
53. Beck AT, Steer RA, Garbin MG. Psychometric properties of the Beck Depression Inventory: Twenty-five years of evaluation. *Clinical Psychology Review* 1988; 8:77-100.
54. Cox JL, Holden JM, Sagovsky R. Detection of postnatal depression. Development of the 10-item Edinburgh Postnatal Depression Scale. *British Journal of Psychiatry* 1987; 150:782-786.
55. Harding TW, de Arango MV, Baltazar J, Climent CE, Ibrahim HH, Ladrido-Ignacio L et al. Mental disorders in primary health care: a study of their frequency and diagnosis in four developing countries. *Psychological Medicine* 1980; 10:231-241.

56. Breslau N, Peterson EL, Kessler RC, Schultz LR. Short screening scale for DSM-IV posttraumatic stress disorder. *American Journal of Psychiatry* 1999; 156:908-911.

57. Achenbach TM, Rescorla LA. *Manual for the ASEBA school-age forms and profiles: An integrated system of multi-informant assessment.* Burlington, VT: Research Center for Children, Youth, and Families, 2001.

58. Bayley N. *Bayley Scales of Infant and Toddler Development: Administration Manual.* 3rd ed. United States of America: Psychorp, 2006.

59. Nakamura BJ, Ebesutani C, Bernstein A, Chorpita BF. A psychometric analysis of the Child Behavior Checklist DSM-Oriented Scales. *Journal of Psychopathology and Behavioral Assessment* 2009; 31:178-189.

60. Murray-Kolb L, Rasmussen Z, Scharf R, Rasheed M, Svensen E, Seidman J et al. The MAL-ED Cohort Study: Methods and Lessons Learned When Assessing Early Child Development and Caregiving Mediators in Infants and Young Children in 8 Low- and Middle-Income Countries. *Clinical Infectious Diseases* 2014; 59:S261-S272.

61. Carter AS, Briggs-Gowan MJ, Jones SM, Little TD. The Infant–Toddler Social and Emotional Assessment (ITSEA): Factor Structure, Reliability, and Validity. *Journal of Abnormal Child Psychology* 2003; 31:495-514.

62. Connors CC, Sitarenios G, Parker JD, Epstein JN. The revised Conners' Parent Rating Scale (CPRS-R): factor structure, reliability, and criterion validity. *Journal of Abnormal Child Psychology* 1998; 26:257-268.

63. Zhang JS, Xu JD, Shen LX. The assessment of Carey's five temperament questionnaires. *Chinese Mental Health Journal* 2000; 14:153-156.

64. Wells G, Shea B, O'Connell D, Peterson J, Welch V, Losos M et al. The Newcastle-Ottawa Scale (NOS) for assessing the quality of nonrandomised studies in meta-analyses. 2013.

65. Mueller M, D'Addario M, Egger M, Cevallos M, Dekkers O, Mugglin C et al. Methods to systematically review and meta-analyse observational studies: a systematic scoping review of recommendations. *BMC Medical Research Methodology* 2018; 18:44.

66. Aldous A, Magnus M, Roberts A, DeVore H, Moriarty T, Schultz CH et al. Challenges in conducting research on sexual violence and HIV and approaches to overcome them. *American Journal of Reproductive Immunology* 2017; 78:e12699

67. Morland L, Goebert D, Onoye J, Frattarelli L, Derauf C, Herbst M et al. Posttraumatic Stress Disorder and Pregnancy Health: Preliminary Update and Implications. *Psychosomatics* 2007; 48:304-308.

68. Garabedian MJ, Lain KY, Hansen WF, Garcia LS, Williams CM, Crofford LJ. Violence Against Women and Postpartum Depression. *Journal of Womens Health* 2011; 20:447-453.

69. Symes L, McFarlane J, Fredland N, Maddoux J, Zhou W. Parenting in the Wake of Abuse: Exploring the Mediating Role of PTSD Symptoms on the Relationship Between Parenting and Child Functioning. *Archives of Psychiatric Nursing* 2016; 30:90-95.

70. Zhang W, Qian L, Deyssenroth M, Lambertini L, Finik J, Ham J et al. Timing of Prenatal Exposure to Trauma and Altered Placental Expressions of HPA-Axis Genes and Genes Driving Neurodevelopment. *Journal of Neuroendocrinology* 2018; 30:1-12.

71. Zijlmans MAC, Riksen-Walraven J, de Weerth C. Associations between maternal prenatal cortisol concentrations and child outcomes: A systematic review. *Neuroscience and Biobehavioral Reviews* 2015; 53:1-24.

Table 1

Sample Summary

Study	Date	Country	Sample size	Age Child Tested	Mothers age at birth	Sample Ethnicity
Tan Retrospective case control	2006	Canada Ontario rural	22 dyads 11 IPV/11 no IPV matched	Various 3.33 – 16.58 M=9.83	Not given	31% Aboriginal, 59% White, 5% Asian, 5% African Canadian
Isaksson Prospective cohort	2015	Nicaragua	70 dyads/14 IPV	9 years	Not given	Nicaraguan (no further breakdown)
Zou Prospective cohort	2015	China Hunan province	223 dyads 86 DV/137 no DV	Birth 10 months	M=27.5	Chinese (no further breakdown)
Roberts Longitudinal cohort	2016	USA 14 States	451 ASD 54,310 controls	Various under 18	24-44	95.5% White, 4.5% other
Levendosky Cross-sectional case control	2016	USA Michigan	182 dyads 58 no IPV/34 prenatal IPV/78 pre & postnatal IPV, 12 postnatal only	11-13 months	18-34 M=24.5	43% White, 33% Black, 15% Multiracial, 9% Hispanic
Martinez-Torteya Prospective cohort longitudinal	2016	USA Midwest urban	119 dyads Breakdown not given	10 years	18-40	50% White, 23% Black, 23% Multiracial, 2% Latino, 1% Native American, 1% Asian
Bianchi Descriptive case control	2016	USA Texas urban	284 dyads All IPV – 77 include prenatal	18 months – 18 years	18-52 At screening	58% Hispanic, 25% Black, 10% White, 5% Biracial, 1.5% Asian, 0.5% Native American

Continued....

Study	Date	Country	Sample size	Age Child Tested	Mothers age at birth	Sample Ethnicity
Koen Prospective cohort longitudinal	2017	South Africa Western Cape urban	111 dyads + 1 child 39 prenatal IPV 55 lifetime IPV	Birth 6 months	22-31 M=25	50% Mixed race, 50% Black
Martinez-Torteya Prospective cohort longitudinal	2017	USA Midwest urban	182 dyads 58 no IPV/34 prenatal IPV/78 pre & postnatal IPV, 12 postnatal only	12 months	18-34 M=24.5	43% White, 33% Black, 15% Multiracial, 9% Latino
Rodriguez Prospective cohort	2018	South Africa Rural	72 dyads 44 IPV/28 no IPV	12 months	19-41 M=29	Not given
Miller-Graaf Longitudinal cohort	2019	USA Sites across 5 states	682 dyads	6 months 8 months 24 months	14-36 M=21.23	64% Black, 19% White, 15% Hispanic, 1% Multiracial, 0.5% Native American, 0.5% Asian

IPV – intimate partner violence, ASD – autistic spectrum disorders, DV – domestic violence

Table 2

Methodology Summary

Study	Recruitment	Assessors Training	Quality	Exposure	Exposure Measure	Outcome	Outcome Measure
Tan, 2006 Retrospective case control	Radio/newspaper ads; posters in hospital, shelters, clinics, university	None - mothers completed questionnaire at home and mailed to study	Reliability/validity good for child data but not mother, small sample, majority Aborigine, rural, recall bias	IPV – prenatal by trimester	AAS Questionnaire	Developmental disorders	CPRS-R:L
Isaksson, 2015 Prospective cohort	From demographic surveillance site addressing IPV (UNAN-Leon)	Trained female assistant; reviewed by field supervisor and main researcher	Nicaragua, very poor (nutrition etc concerns), LMIC, Spanish versions, no psychometrics and reliability issue with saliva samples	DV	WHO DV questionnaire, SRQ-20 x 2 and mother cortisol measures	Internalising/ externalising behaviours	CBCL/6-18, infant cortisol measures
Zou, 2015 Prospective cohort	1 health clinic in Changsha	Senior psychiatrist, obstetrician, nurse	Chinese assessment with psychometrics, DV shameful in culture- possible investigation bias	IPV/DV	AAS Chinese version, EPDS – depression	Infant development, plasma cortisol x2	BSID, RITQ-Chinese, umbilical cord blood
Roberts, 2016 Longitudinal cohort	Nurses from Nurses Health Study II, from 14 populous states	Trained professionals with experience in ADI-R	No psychometrics, validation by 50, majority white nurses – limited generalisability. Adv – not clinical sample	IPV - perinatal	AAS & supplemental questionnaire	ASD	50 randomly took ADI-R

continued....

Study	Recruitment	Assessors Training	Quality	Exposure	Exposure Measure	Outcome	Outcome Measure
Levendosky, 2016 Cross-sectional case control	Fliers in community, social services organisations, local business, social media	2 trained graduate and/or undergraduate students	Only English speaking. Some psychometrics	IPV, no IPV - pre/postnatal	SVAWS x2, cortisol, EPDS, MPSS-SR, PTSD, BSI	Internalising/ externalising behaviours	Arm restraint and salivary cortisol, ITSEA
Martinez-Torteya, 2016 Prospective cohort longitudinal	Fliers at clinics, business, social services, birth classes, prosecutors office, DV shelter	Advanced undergraduate and graduate research assistants	Person oriented, reliability/validity good, only English speaking, possible IPV social response bias	IPV - prenatal & lifetime	SVAWS annual, BDI	Behaviour disorder, cortisol	K-SADS, CBCL/6-18, CDI, BASC, TSST-C
Bianchi, 2016 Descriptive case control	Safe shelters, District Attorney's office	Not mentioned, no informed consent mentioned	English and Spanish only, no psychometrics	IPV – prenatal & 6 months postnatal	5 questions	Internalising/ externalising behaviours	CBCL
Koen, 2017 Prospective cohort longitudinal	Recruited from *Drakenstein Child Health Study* – 2 primary clinics	Trained field workers, physiotherapist, nurse & developmental paediatrician	3 languages used, good psychometrics, use in SA/LMIC setting	Trauma - includes IPV, PTSD	CTQ, IPV questionnaire, MINI, BDI/EPDS, SRQ-20	Head circumference, infant development	Fenton growth chart, BSID III
Martinez-Torteya, 2017 Prospective cohort longitudinal	Fliers in community, social services organisations, local business, social media	2 trained graduate and/or undergraduate students	Low income but ethnic diversity, only English, some psychometrics given	DV/IPV PTSD	SVAWS x2 with event calendar, EPDS, PTSD symptom scale, GAD7, PRAMS	Internalising/ externalising behaviours, cortisol	ITSEA, salivary analysis

continued...

Study	Recruitment	Assessors Training	Quality	Exposure	Exposure Measure	Outcome	Outcome Measure
Rodriguez, 2018 Prospective cohort	From cluster RCT that recruited from 12 community health centres	Trained staff	3 languages, addresses issues with measurement scales used in South Africa	IPV – prenatal & postnatal	Conflicts Tactics Scale	Infant development	BSID III
Miller-Graaf, 2019 Longitudinal cohort	From primary care facilities & community agencies serving pregnant women	None mentioned	Good psychometrics reported	IPV – prenatal & perinatal	1 question	Child aggression - added detail on aggression towards mother	ITSEA

IPV – intimate partner violence**,** PTSD – post traumatic stress disorder, DV – domestic violence, LMIC – low/middle income country

Exposure assessments: **AAS** – Abuse Assessment Screen, **SRQ** – Self-Reporting Questionnaire, **EPDS** – Edinburgh Postnatal Depression Scale, **SVAWS** – Severity of Violence against Women Scales, **MPSS-SR** – Modified PTSD Symptom Scale – Self Report, **BSI** – Brief Symptom Inventory, **BDI** – Beck Depression Inventory, **CTQ** – Childhood Trauma Questionnaire, **MINI** – Mini International Neuropsychiatric Interview, **GAD7** – General Anxiety Disorder 7, **PRAMS** – Pregnancy Risk Assessment Monitoring System

Outcome assessments: **CPRS-R:L –** 80 item Parent Rating Scale – Revised:Long Form, **ADI-R –** Autism Diagnostic Interview, **CBCL/16-18** – Child Behaviour Checklist – ages 6-18, **BSID** – Bayleys Scales of Infant and Toddler Development, **RITQ** – Revised Infant Temperament Questionnaire, **ITSEA** – Infant Social and Emotional Assessment, **K-SADS** - Kiddie Schedule for Affective Disorders and Schizophrenia, **CDI** – Children's Depression Inventory, **BASC** – Behaviour Assessment System for Children, **TSST-C** – Trier's Social Stress Test for children

Table 3

Covariates

Study	Date	Socio-Demographics	Mental Health	Birth Outcomes	Gestational Risks	Post-birth Risks
Tan	2006	Age/SES/marital status/ethnicity	None	Risks excluded	Risks excluded	None
Isaksson	2015	Age/SES/ethnicity	Emotional distress	Yes	None	Postnatal IPV
Zou	2015	Age/SES	Risks excluded	Risks excluded	Risks excluded	Postnatal depression
Roberts	2016	Age/SES/ethnicity	Childhood abuse	Yes	Yes	Postnatal IPV
Levendosky	2016	Age/SES/marital status/ethnicity	Depression, PTSD	Preterm excluded	Substance misuse, illness excluded	Postnatal IPV, depression
Martinez-Torteya	2016	Age/SES/marital status/ethnicity	Depression, anxiety, emotional distress	None	None	Postnatal IPV, harsh parenting
Bianchi	2016	Age/SES/ethnicity	None	Yes	None	Breastfeeding in hospitalisation
Koen	2017	Age/SES/marital status/ethnicity	Depression, stress	Yes	Yes	Postnatal depression
Martinez-Torteya	2017	Age/SES/marital status/ethnicity	Depression, anxiety, PTSD	Preterm excluded	Substance misuse, illness excluded	Postnatal IPV, stressful events
Rodriguez	2018	Age/SES/marital status	None	None	None	Postnatal IPV
Miller-Graaf	2019	Age/SES/ethnicity	None	None	None	Postnatal depression, parenting

SES – socio-economic status, IPV – intimate partner violence, PTSD – post traumatic stress disorder

Table 4

Findings

Study	Initial findings	Confounders	Adjusted Findings
Tan, 2006	Differences found in externalising behaviours (oppositional, hyperactivity, attention deficit, hyperactive-impulsive, social problems). Exposed children had *markedly atypical* scores on internalising (with exception of perfectionism).	No significant differences in groups for children's developmental and health history. No mothers used tobacco, alcohol or illicit drugs. Witnessing abuse and child abuse were controlled for in study.	Prenatal IPV associated with externalising problems: ADHD (t[1,20]=2.13, p<.05) & social problems (t[1,20]=3.67, p<.05).
Isaksson, 2015	Morning maternal cortisol positively associated with offspring total CBCL scores 9 years later (*p*=.31; p=.009), especially externalising (*p*=.35; p=.003) but not with child cortisol. Afternoon cortisol associated with externalising only (*p*=.33; p=.006)	Gender of child, residency, SES status during pregnancy, gestational age, birth height and weight, maternal distress and maternal exposure to abuse (when child aged 9). Gestational week for maternal saliva sampling.	Maternal cortisol levels associated with child externalising problems at age 9. No association found with prenatal DV and either child cortisol levels or CBCL scores.
Zou, 2015	SES, unplanned pregnancy and abortion history differences significant between groups (p<.05). DV group recorded excess postnatal depression (65.1% vs 10.2%, p<.001) higher RITQ scores in rhythmicity, withdrawal, mood, distractibility and persistence. PDI scores on BSID significantly lower in DV group.	Participants excluded for severe disease or complications unrelated to DV - gestational diabetes, hypertension, heart disease, tuberculosis, nephropathy, hyperthyroidism, severe infection, mental illness. Neonates excluded for disease or complications, prematurity or low birth weight. Age, SES, education, planned pregnancy, previous abortions and post-natal depression recorded.	Prenatal DV associated with distractibility of RITQ (p=0.0069) and mood. Mood from biochemical indices with Glu (ß=0.216, p=.047, effect size 0.047) and GABA (ß=0.227, p=.037, effect size 0.051).
Roberts, 2016	Physical harm experienced more in younger, lower SES and less recent births. Women exposed in both of 2 calendar years before birth year were somewhat more likely to have child with ASD.	Adjusted for maternal age, birth year, child's sex, mother's childhood SES and mother's childhood abuse. Further adjusting for smoking, alcohol consumption in pregnancy, preterm, low birth weight, gestational diabetes, preeclampsia and prior abortions. Sibling analysis used.	Neither physical abuse during pregnancy nor repeated abuse associated with ASD. Only IPV in 2 calendar years before birth associated with ASD (RR=2.16 [95% CI=1.33, 3.50]). Sibling analysis similar to unrelated children.

Study	Initial findings	Confounders	Adjusted Findings
Levendosky, 2016	Infant cortisol associated with prenatal IPV (p<.05). Effects of prenatal IPV and post-natal IPV were not equivalent. Maternal mental health mediated effects of prenatal IPV.	Ethnicity and infant gender recorded. Education, income, marital status, maternal age, negative life events and use of street drugs combined as cumulative risk. Model adjusted for maternal mental health (anxiety, depression and PTSD).	Prenatal IPV associated with infant HPA axis reactivity (r=0.15, p<.05). Higher levels of mother reported internalizing and externalising problems (std ß=.09, p=.02). Maternal mental health mediated effects (std ß=0.10, p=0.01). When prenatal IPV included little evidence of association for postnatal IPV (r=0.00, p=.97).
Martinez-Torteya, 2016	Pregnancy IPV associated with maternal distress and lifetime IPV exposure. Cortisol levels strongly associated with IPV during pregnancy. Pregnancy IPV had significant effect on externalising (std ß=0.29, p=.00) but not on internalising, although maternal distress did (std ß=0.26, p=.01).	Adjusted for maternal distress during pregnancy, lifetime IPV exposure and postnatal IPV.	Prenatal IPV associated with child & mother reported externalising (std ß=0.29, p=.00) and child reported internalising symptoms (std ß=0.37, p=.00). Prenatal IPV predicted profile of cortisol hyperactivity, only associated with mother reported internalising symptoms (std ß=0.32, p=.00).
Bianchi, 2016	Most participants reported child had internalising problems (n=215), 201 reported externalising problems or a combination. Strong association found for IPV during pregnancy and continued IPV after birth.	Ethnicity, infant sex, education and immigration status recorded. Also birth method, birth weight and initiation of breast feeding. Investigation of conception rape, IPV 6 months after birth and child exposure to IPV.	Greater proportion of children in IPV group were clinical/borderline for internalising ($x^2(2)=6.88$, p=.009, Cramer's V=.16) and externalising ($x^2(2)=13.84$, p<.001, Cramer's V=.22). Association found between two groups and total problems ($x^2(2)=16.11$, p<.001, Camer's V=.24).
Koen, 2017	Crude associations for maternal PTSD and infant development in fine motor (p=.015) and adaptive behaviour-motor subscales (p=.004) on BSID III.	Maternal age, marital status, education, employment and income recorded. Depression, stressful life events, postnatal depression, substance misuse (prevalent in the study), PTSD and lifetime abuse were measured. Weight, height and head circumference measured at birth and 6 months.	PTSD associated with lower scores on the adaptive behaviour-motor subscale. Infants of mothers with PTSD scored on average 1.3 units (95% CI [0.4, 2.3]) lower on the adaptive behaviour-motor subscale (p=0.007).
Martinez-Torteya, 2017	Infant sex and ethnicity not associated with internalising but ethnic minorities and males scored higher on externalising behaviours (p<.00 and p<.05 respectively). Maternal smoking was associated with both (r=-.22, p<.05). Alcohol use associated with cortisol (r= -.18, p<.05).	Ethnicity and infant gender recorded. Education, income, marital status, maternal age, negative life events and use of street drugs combined as cumulative risk. Model adjusted for maternal mental health (anxiety, depression and PTSD).	Prenatal IPV only associated with externalising behaviours (std ß=.33, p=.00). Internalising behaviour, moderated by physiological reactivity to stress - effects of IPV strongest for high cortisol/low sAA reactivity profile and less for symmetrical cortisol/sAA reactivity profile.

Study	Initial findings	Confounders	Adjusted Findings
Rodriguez, 2018	Postnatal IPV and developmental delays associated but only before adjusting.	Age, education, income, relationship status, employment and disclosure of HIV status to partner were reported.	No association between IPV and developmental delays.
Miller-Graaf, 2019	80% reported low levels of depression 6 months post-partum. Prenatal violence predicted higher levels of depressive symptoms at 6 months, poorer warm responsiveness at 8 months and higher child aggression/defiance towards mother.	Maternal age, education, ethnicity, depressive symptoms and warm/sensitive parenting were assessed.	Prenatal IPV was associated with child aggression/defiance towards mother only at 24 months. (b=0.08, $s.e$=0.04, p<.01). Adolescent mothers had more aggressive toddlers.

ADHD – Attention Deficit Hyperactivity Disorder; ASD – autistic spectrum disorders; PTSD – post traumatic stress disorder; CBCL – Child Behaviour Checklist; DV – domestic violence; SES – socio-economic status; RITQ – Revised Infant Temperament Questionnaire; BSID – Bayleys Scales of Infant and Toddler Development; IPV – intimate partner violence

Search Summary