

Abstract

Objectives: This review examines home visiting programmes that specifically provide home based support to vulnerable, socially disadvantaged women who are either pregnant or have recently become a new parent. Home visiting programmes often report multiple outcomes. The purpose of this review is to systematically summarise how effective home visiting programmes are at improving young children's language development.

Data sources: A comprehensive search of four online databases (Embase, Emcare, Psycinfo and Medline) between 1990 and 2018 was conducted, as well as a hand search of the references of relevant studies.

Review method: Studies were screened with N = 11 meeting the inclusion/exclusion criteria. The risk of bias of each study was assessed. To enable comparisons between home visiting programmes, relevant data was extracted using an adapted version of the Cochrane Public Health Group Data Extraction and Assessment Template.

Results: Most of the home visiting programmes had been established in America. Six of the eleven studies reported positive language outcomes for children. Where statistical data was reported, the magnitude of the difference between the intervention and control groups represented small effect sizes. Nine different language measures were used, reporting on varying domains of language development rendering comparisons across programmes difficult. Most studies failed to report the duration of home visits, though studies which started prenatally showed the most promise in improving children's language development.

Conclusion: Home visiting programmes targeted at socially disadvantaged women and their children have the potential to positively influence the language development of the child. This review highlights that not all home visiting programmes measure the impact that the programme has on children's language development, and not all home visiting programmes achieve positive language outcomes. Initiating visits prenatally may help towards the improvement of children's language development. Future evaluations of home visiting programmes should explore this finding further, consider the language assessment tools selected, and improve on the reporting of their language results.

Key words: Child; Home visits; Infant, high risk; Language; Socioeconomic factors; Speech; Systematic review

Highlights

- Home Visiting Programmes have been set up and researched in countries all over the world, often with varied research goals and delivering mixed outcomes. This is the first systematic review to specifically focus upon the impact that the Home Visiting Programmes model has on the language development of the young children involved. Peacock et al. (2013) briefly explored language development in Home Visiting Programmes reporting an association with improved language outcomes, though the focus on language was brief as their paper reported on a multitude of outcomes assessed through Home Visiting Programmes.
- The paper is also the first to consider what factors of the Home Visiting Programme model create the best opportunities for a positive impact upon the children's language development.

What this paper adds

- This paper highlights that not all home visiting programmes measure the impact that the programme has on children's language development, and not all home visiting programmes achieve positive language outcomes. Home Visiting Programmes that initiate their visits prenatally may help towards the improvement of children's language development
- The paper also highlights the wide and varying range of language assessment tools that programmes use, how the language scores are reported, and the challenge this presents for analysis, as well as highlighting the fact that many studies of within this area are limited with regards to the information they report relating to the nature and delivery of the home visiting programme.

Introduction

Becoming a parent can be both an exciting and stressful time. For many, this new experience is often challenging, though this can be particularly felt when the mother lives within poor financial circumstances, has limited or no access to family and social support, or has added complications such as an addiction or an unstable domestic life (Parkes, Sweeting and Wright, 2015). Children (particularly infants and toddlers) who face growing up in financial hardship and social disadvantage face a range of complex circumstances and life challenges that have the potential to contribute towards a negative impact on their health, education and vocational success (Garner et al. 2012). To help mitigate the potential negative consequences for both mothers' and children living in such challenging circumstances, interventions delivered during the first years of a child's life can lead to improvements in health-related outcomes that persist into adulthood (Campbell and Scott, 2011; Marmot et al. 2008).

In order to support those mothers and families that are deemed to be at risk by virtue of their social circumstances, many countries have established Home Visiting Programmes. Home Visiting Programmes are interventions that provide family-focused services within the family's primary residence, which aim to address health, social service and educational needs (Ivan et al. 2009). The appeal of Home Visiting Programmes includes their ability to circumnavigate barriers to service usage, allowing the home visitor to assess the home environment and neighbourhood (Wasik, 1993) and tailor the service to meet the needs of the family. In many cases, Home Visiting Programmes use a two-generational approach simultaneously focusing upon the vulnerable mother's and her child's social and economic needs (Finello et al. 2016). These services tend to start during pregnancy or early infancy and continue over the course of the first few years of the child's life. Those delivering the home visits vary in their background experience; they may be healthcare professionals,

paraprofessionals or volunteers. In most cases, the home visitors will have received some level of training for the role from the service provider, with the aim of supporting the parent and the child through pregnancy and / or during a set time period following the child's birth (Gomby et al. 1999).

The published literature surrounding Home Visiting Programmes reveals that the programmes vary considerably with regards to their target population, the frequency and duration of visits, the implementation method, and the outcomes targeted for change. Outcomes that are typically targeted by Home Visiting Programmes include, but are not limited to, improving birth outcomes (e.g. increased birth weight, attendance at antenatal classes (Issel et al. 2011; Ichikawa et al. 2015), increasing the rate of breastfeeding (McInnes and Stone, 2001), improving immunization rates (Johnson et al. 1993), reducing child abuse and neglect (Chaffin, Hecht, Bard, Silovsky and Beasley, 2012), reducing the number of hospitalisations (Johnson et al. 1993), supporting the child's physical growth (Le Roux et al. 2010), supporting the child's cognitive development (Grantham-McGregor et al. 1991; Hamadani et al. 2006), improving the child's behaviour (Caldera et al. 2007), and supporting the mental health and wellbeing of the mother (Barnet et al. 2002). Despite their differences, Home Visiting Programmes across the world generally share a number of commonalities. They deliver a structured service within the family's home and aim to have a positive impact upon the knowledge, beliefs and parenting practices of the caregiver in order to improve children's outcomes (Wasik and Bryant, 2000).

The evidence to support the use of Home Visiting Programmes is mixed. For example, whilst several randomised control trials have found positive outcomes for Home Visiting Programmes (for example, Bugental, et al. 2002; Lee, Mitchell-Herzfeld, et al. 2010), other studies have not found significant outcomes (for example, Barth, 1991; Kartin, et al. 2002; Duggan et al. 2004). It is apparent that not all Home Visiting Programmes may

be effective for improving the health and wellbeing of mothers and their children. In addition to individual randomised control trials, several systematic reviews and meta-analyses have explored the use of Home Visiting Programmes with socially at-risk families. Systematic reviews such as a study conducted by Peacock and colleagues (2013) have explored the effectiveness of Home Visiting Programmes across multiple domains of child development. Stamuli et al. (2015) studied the economic effectiveness of Home Visiting Programmes, whilst other reviews have examined specific outcomes such as child maltreatment and violence (Avellar and Supplee, 2013; Bilukha et al. 2005) or improvements in parenting skills and the home environment (Hadian, et al. 2018). However, to our knowledge, studies of the impact of Home Visiting Programmes on children's language development have not been systematically examined.

The acquisition of language is a key developmental milestone of early childhood that has a significant impact upon other areas of life, such as providing the foundation for future reading comprehension (Oakhill et al. 2003; Muter, et al. 2004), whilst elevated rates of disruptive behaviour have been reported amongst children with language delay or disorder (Van Daal, Verhoeven & van Balkom, 2007). Language development is also a sensitive indicator of neuromotor impairment, hearing loss, general learning disabilities and specific language and communication difficulties (Dockrell, 2001). Multiple studies have found that children growing up in lower socio-economic status households (the families typically targeted by Home Visiting Programmes) show poorer language skills than their peers (Arriaga et al. 1998; Huttenlocher, et al. 2002; Rescorla and Alley 2001). This deficit can be identified as early as 18 months of age, with children brought up in higher socioeconomic status households knowing 60% more words and being faster at comprehending words than their lower socio-economic status peers (Fernald et al. 2013). In the United Kingdom, children who qualify for free school meals and live within deprived neighbourhoods are 2.3

times more likely to be identified as having speech, language and communication needs (Dockrell et al. 2012). Similarly, at school entry, children from low income families are almost one year behind their higher family income peers in terms of vocabulary development (Waldfogel and Washbrook, 2010). This difference is perhaps most starkly underlined by the research of Hart and Risley (1995) who estimated that by 3 years of age, children growing up in low socio-economic status households are exposed to approximately thirty-million fewer spoken words than children from higher socio-economic status households. Increased awareness of this ‘word gap’ in children’s language development between socio-economic classes led the UK government to announce a multi-million pound investment to help support parents and carers improve their children’s language, vocabulary and social skills (Department for Education, 2017).

Amongst the many reasons for this disparity, a growing body of literature has shown that parents from low socio-economic status households speak and gesture significantly less with their children (Rowe and Goldin-Meadow, 2009), use a greater number of directives in their speech (Hart et al. 1995; Hoff 2006), and use shorter utterances and a reduced vocabulary (Hoff, 2003). Several reasons have been hypothesised for this discrepancy, including the impact of lower levels of parental education (Raizada and Kishiyama, 2010), the neurological impact of the stress associated with socio-economic deprivation (Noble et al. 2005; Farah et al. 2006) and parenting style (Hashima and Amato, 1994). Nonetheless, some studies have shown that if parents can be supported to be more verbally responsive to their offspring during early childhood, improvements in children’s language skills can be made (Nicely, Tamis-LeMonda and Bornstein, 1999; Paavola et al., 2005; Tamis-LeMonda and Bornstein, 2002). Given the heterogeneity in the outcomes targeted by Home Visiting Programmes, it is less clear whether such multi-faceted interventions that aim to improve multiple domains of child development lead to improvements in children’s language and

communication skills. To address this gap in the literature, the aim of this systematic review is to determine whether Home Visiting Programmes that are not routine, but have been specifically designed to target and support mothers and their children living in low income families lead to an improvement in children's language development.

Method

Literature Search Strategies

In order to provide a framework to guide the search strategy, the recommendations set forth by the NHS Centre for Reviews and Dissemination (2001) and the Cochrane Collaboration (Higgins & Green, 2009) were drawn upon. The literature search was carried out through the searching of Embase, Emcare, PsycInfo and Medline databases. The search terms were identified through an examination of the language and terms used within the research literature that has focussed on Home Visiting Programmes. The search terms were chosen in order to identify children (child* OR exp/infant OR baby OR babies OR preschool), language (language OR speech OR word* OR vocab*), home visiting (home visit* OR house call OR home intervention OR home based), low socioeconomic status (low SES OR low socioeconomic OR poor fami* OR poverty OR disadvantaged) and mothers or women who were pregnant (mother* OR pregnant OR post-partum OR prenatal OR neonatal OR perinatal). Results were restricted to those published during and after 1990 and those studies published in the English language. The date range was selected as it allowed a substantial time period of over 27 years of research and was in line with the time scales of other systematic reviews conducted in this area (e.g. Peacock et al. 2013). In addition to the database search, the references cited in the identified papers were also examined for further relevant papers. The search was conducted in February 2018 and updated in January 2020.

Study screening against inclusion criteria

Each study identified through the literature search was screened by examining the title and/or abstract. Each study was categorised into those deemed to be potentially eligible for inclusion and those that clearly did not fit the inclusion criteria. The full papers of those studies deemed potentially eligible were explored in further detail to determine whether they met the following inclusion criteria: (1) the study involved an evaluation of a Home Visiting

Programme delivered by healthcare professionals or paraprofessional: (2) the study used a randomised control trial design: (3) the study population was pregnant women or women supported by a Home Visiting Programme that began within the first three months of the birth of their child: (4) the women involved were defined as living in social deprivation and/or were on a low income: (5) the study reported a child language outcome following a period of home intervention support: and (6) home visiting was the primary service delivery strategy. The screening of studies was carried out independently by two reviewers. Where differences were found, both reviewers discussed the paper to establish whether it met the inclusion criteria.

Assessing study quality

Those studies that met the inclusion criteria were assessed for their risk of bias using the Cochrane Risk of Bias Tool (Higgins et al. 2010) and the Cochrane handbook (Higgins and Green, 2011). Biases were rated as being low risk, high risk or an unclear by the first author. A second researcher used the same tool to independently assess the risk of bias of a random sample of 4 studies, comprising 24 items, representing 36% of the total study sample and above the 10% minimum sample suggested by NICE (2012). Agreement between the coders was calculated as $\kappa = .69$; $n=24$. Disagreements were resolved following a discussion between the two raters and a consensus decision was made.

Data extraction

Data extraction was performed on those studies that met the inclusion criteria using an adapted version of the Cochrane Public Health Group Data Extraction and Assessment Template (The Cochrane Public Health Group, 2011). This adapted version was pilot tested on two studies in order to establish its viability for the task before being used for each study. A wide range of data was extracted for each study to enable the analysis and comparison of each study across four key categories: (1) Study aims and design; (2) participant details; (3)

Home Visiting Programme process and procedure; and (4) language assessment and outcomes.

Results

Literature search

The database search identified a total of 9610 studies. This was reduced to 4572 once duplicates were removed. A search of reference lists of all potentially relevant studies identified a further 21 relevant papers, resulting in 4593 published studies assessed for their relevance.

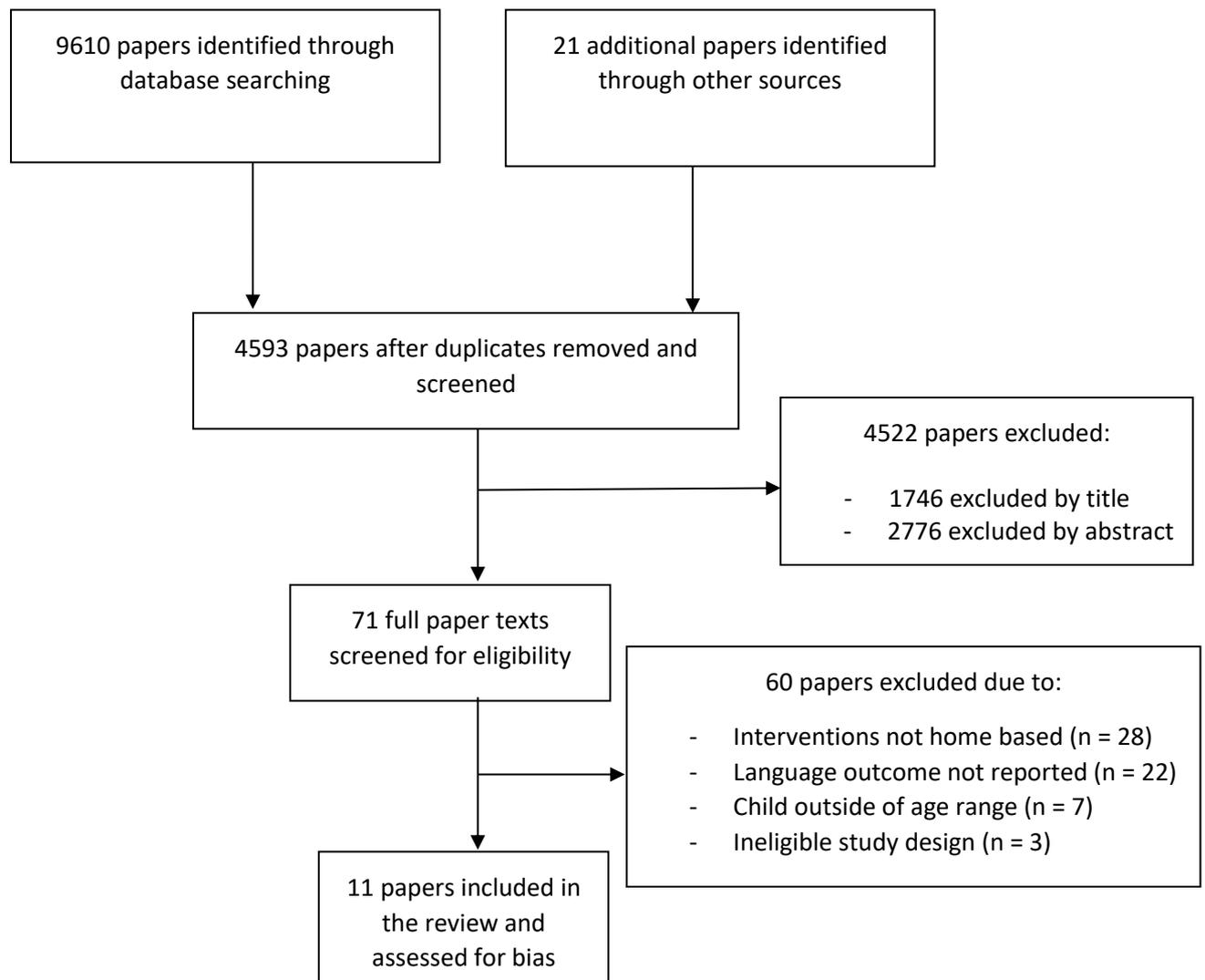


Figure 1. Flow chart detailing the study selection process

Relevance and validity

Of the 4593 studies reviewed, 1746 were excluded by title alone, with 2776 studies excluded following a review of their abstracts. A detailed examination of the full papers for the remaining 71 studies was conducted against the inclusion criteria. This process yielded a final total of 11 studies (see figure 1). A quality assessment was carried out on each of the 11 studies, with all studies assessed for their risk of bias (Table 1). The quality assessment process did not lead to the exclusion of any study. Given that the nature of the intervention procedure for all the included studies involved home visits over an extended period, it was not possible for any study to blind its participants and personnel as to which intervention group they had been allocated to. Therefore, this risk of bias indicator was assessed as unknown for all the involved studies. The quality assessment showed that although there were several unknown areas of bias, the majority of domains within the studies were judged to have a low level of bias. Only three judgements of high risk of bias were made, all relating to the incomplete reporting of the language outcome data due to high levels of attrition (Nair et al. 2003, Olds et al. 2004b and Sierau et al. 2015).

Table 1

Quality Assessment Outcomes for included studies

	Random Sequence generation	Allocation Concealment	Blinding of participants and Personnel	Blinding of assessment outcome	Incomplete Outcome data	Selective Reporting	Other Bias
Aracena et al. 2009	Orange	Orange	Orange	Orange	Green	Green	Green
King et al. 2005	Orange	Orange	Orange	Orange	Green	Green	Green
Nair et al. 2003	Orange	Orange	Orange	Green	Red	Green	Green
Olds et al. 2002	Green	Green	Orange	Green	Orange	Green	Green
Olds et al. 2004a	Green	Green	Orange	Green	Green	Green	Green
Olds et al. 2004b	Green	Green	Orange	Orange	Red	Green	Green
Olds et al. 2014	Green	Green	Orange	Green	Green	Green	Green
Robling et al. 2016	Green	Green	Orange	Green	Green	Green	Green
Sierau et al. 2015	Green	Orange	Orange	Green	Red	Green	Green
Schwarz et al. 2012	Green	Green	Orange	Green	Green	Green	Green
Tomlinson et al. 2016	Orange	Orange	Orange	Orange	Green	Green	Green

NB. Green = low risk, orange = unknown risk, red = high risk.

Table 2

Study Characteristics

Author	Home Visit Programme name and location	Home Visitor	Home visitor guidelines and training	Number of mother participants	Intervention period	Average number & average duration of home visits	Control group support
<i>Arcena et al. 2009</i>	Un-named (Chile)	Health educators (under the guidance of nurse-midwives)	Trained in adolescence, adolescent pregnancy, infant development, transgenerational conflicts and couple relationships. Guidelines and weekly supervision provided.	Total N=90; Intervention N=45; Control N=45	Pregnancy to 12 months	Monthly visits. Duration - one hour	Standard care from health centres. An average of 10 prenatal consultations with the nurse midwife of the community health centre.
<i>King et al. 2005</i>	Hawaii Healthy Start Program (USA)	Trained paraprofessionals	Six weeks of training.	Total N=643; Intervention N=373; Control N=270	Pregnancy to 35 months	Weekly to quarterly visits. Unknown duration.	Standard care not specified in further detail
<i>Nair et al. 2003</i>	Un-named (USA)	Trained lay visitors	Trained using the HELP at Home Curriculum (HELP, 1991). A comprehensive programme containing 650 developmental skills from birth to 36 months.	Total N=171; Intervention N=84; Control N=87	Birth to 24-months	Weekly visits (0-24mths). Unknown duration	Standard care specified in limited detail. Brief monthly tracking visits and follow-up assessments at 6, 12, 18 and 24 months and then annual visits.

<i>Olds et al. 2002, 2004a, 2014</i>	Nurse Family Partnership (Denver, USA)	Paraprofessionals & nurses	One month of extensive training	Total N=735 Paraprofessional N=245 Nurse N=235 Control N=255	Pregnancy to 24 months old	Paraprofessional visits: 6.3 prenatal visits (range: 0–21); 16 visits during infancy (range: 0–78). Nurse visits: 6.5 prenatal visits (range: 0–17); 21 visits during infancy (range: 0–71). Unknown duration.	Children’s developmental screening and referral services at 6, 12, 15, 21, and 24 months old.
<i>Olds et al. 2004b</i>	Nurse Family Partnership (Memphis, USA)	Nurses	Detailed visit by visit guidelines provided for the nurse home visitors	Total N=543 Intervention N=228 Control N=515	Pregnancy to 24 months old	7 prenatal visits (range: 0–18 visits) and 26 visits during first 2 years (range: 0–71 visits). Unknown duration.	Free transportation for scheduled prenatal care appointments plus developmental screening and referral services for the child at 6, 12, and 24 months of age.
<i>Robling et al. 2016</i>	Family Nurse Partnership (UK)	Family nurses (UK Nursing and Midwifery council registrants)	All family nurse visitors received training in the delivery of the programme	Total N=1529 Intervention N=719 Control N=810	Pregnancy to 24 months old	Medium of 10 prenatal visits, 19 visits (infancy), 13 visits (toddler). Duration of visits = 79.14 minutes (range 30 to 180 minutes).	NHS care as usual, including statutory and non-statutory services.

<i>Sierau et al. 2015</i>	Pro-Kind - based on Nurse Family partnership (Germany)	Trained midwives and social workers and one paediatric nurse	Training on the basic programme principles.	Total N=755 Intervention N=394 Control N=361	Pregnancy - 24 months old	Weekly visits from prenatal to one month old, bi-weekly and then monthly for the last six months. Unknown duration.	Support from existing health care and social services. No further details provided.
<i>Schwarz et al. 2012</i>	The MOM program (USA)	Masters level nurse practitioners and two trained community workers	Extensive training for each home visit using a manualised visit by visit protocol	Total N=302 Intervention N=152 Control N=150	3 months to 36 months old	8 home visits over 3 years. Duration of 15 minutes.	Mothers received an information booklet on child and family services.
<i>Tomlinson et al. 2016</i>	Philani Intervention Program (South Africa)	Trained township women	Training over 1 month in cognitive-behavioural change strategies. Bi-weekly supervision. Structured home visits.	Total N=1238 Intervention N= 644 Control N=594	Pregnancy to 36 months	6 prenatal visits (SD = 3.8); 5 postnatal visits 0-2 months postpartum (SD=1.9); 1.4 visits per month between 2 to 6 months old (range = 0.1–6.4). Biannual visits after 6 months. Average duration of visit = 31 minutes.	Standard antenatal clinic care within 5km of each neighbourhood.

Included studies

All studies included in this review were randomized control trials, with over half the studies based on Home Visiting Programmes conducted in North America (N=7), with one study based in each of the following countries: UK, Germany, South Africa and Chile. Of the 11 studies, two (Olds et al. 2004a & 2014) were long term follow up studies of Olds (2002) Nurse Family Partnership. Each paper assessed the children's language development at different ages, so were included in this review. The number of mothers recruited to the studies ranged greatly, from 90 mothers (Arcena et al. 2009) to 1529 mothers (Robling et al. 2016). In addition, the ages of the mothers recruited to the studies (where specified) was typically young (teenage and early twenties). This could be a result of the Home Visiting Programmes taking place within low income areas which may have a high proportion of young mothers and/or the programme eligibility criteria. The rate of attrition across the studies ranged from 20% (King et al. 2005) to 56% (Olds et al. 2004b). A majority of the home visits across the studies were carried out by trained professionals, including nurses, midwives, health care and social care professionals. Four of the studies used 'paraprofessionals' (individuals not fully licenced or fully qualified) as part of their home visits (King et al. 2005; Olds et al 2002; 2004; 2014). It is noteworthy that a more specific definition of the employment background of 'paraprofessionals' was not provided. Two studies used non-healthcare professionals (Nair et al. 2003 and Tomlinson et al. 2016), though training was provided. Four of the studies specified the gender balance of the children who were assessed as part of the intervention (Aracena et al. 2009, King et al. 2005, Robling et al. 2016, and Schwarz et al. 2012). Aracena et al. (2009) reported the intervention group having a bias towards more male children (61% to 39%). All other studies that specified their gender balance were close to equal. The range of average maternal age from across the included studies was from 17.3 years old, SD=0.23 (Aracena et al. 2009) to 23.1 years old,

SD=5.6 (Tomlinson et al. 2016). All the mothers recruited to the included studies came from low socioeconomic backgrounds and were deemed socially at risk by the study researchers. Additionally, the aims of each Home Visiting Programme were set out in the research papers. Across all of the studies, there was a broad range of aims, though the aims can be categorised into one of 3 categories:

- *Supporting the mother* – Developing her identity and supporting her life plans, helping her become economically self-sufficient and developing her parenting skills
- *Supporting the child* – Healthy child development, developing the child’s relationships with those around them and developing a healthy home environment.
- *Health promotion* - Improving the health of the mother, foetus and child, reducing alcohol and substance misuse, increasing links to medical and early intervention services and reducing HIV infection and transmission.

See the supplementary section of this paper for Table 3 and Table 4, which both provide a summary of the aims of each of the Home Visiting Programme and an outline of the support that was available to the control groups. An overview of the participant characteristics can be seen below in Table 5.

Table 5

Participant Characteristics

Author	Average age of mothers at time of recruitment	Socioeconomic description of mothers	Child Gender (as specified in study)
<i>Arcena et al. 2009</i>	Intervention: 17.3 (SD = 0.23) Control: 17.15 (SD=0.22)	First time mothers living within an extremely poor neighbourhood of Santiago de Chile.	Intervention - 39% female and 61% male. Control group - 55% female and 45% male.
<i>King et al. 2005</i>	Intervention: 23.7 (SD=5.9) Control: 22.9 (SD=5.4)	Mothers socially at risk through poor socioeconomic circumstances and high stress levels. Deemed at risk of poor health and developmental outcomes or child abuse and neglect.	Intervention - 43% male: 57% female. Control - 49% boys: 51% girls
<i>Nair et al. 2003</i>	Age not specified	Substance abusing mothers living within risky environments	Gender not specified
<i>Olds et al. 2002, 2004a, 2014</i>	19 years old (SD - 3.99)	Women from a low income background	Gender not specified
<i>Olds et al. 2004b</i>	64% were 18 years of age at registration	Unmarried mothers with a household income at or below the federal poverty line	Gender not specified
<i>Robling et al. 2016</i>	Median age 17.9 years	Living within the catchment area of a Family Nurse Partnership Team. 65% not in employment, education or training.	Male – 51.5% Female – 48.5%

<i>Sierau et al. 2015</i>	21 years old	Economic risk factors (e.g., unemployment, over-indebtedness), at least one social risk factor (e.g., poor education, experiences of violence, or neglect).	Gender not specified
<i>Schwarz et el. 2012</i>	23.1 years (<i>SD</i> = 5.6)	Women living in an area of high poverty	Male – 46% Female - 54%
<i>Tomlinson et al. 2016</i>	Age not specified	Socially deprived women, low income, high unemployment	Gender not specified

Language Outcomes

Due to the considerable variation in the measures used by the identified studies, a meta-analysis could not be performed. Six of the eleven studies reported significant improvements in children's language outcomes. Where statistical data was reported, the magnitude of the difference between the intervention and control groups represented small effect sizes. These six studies were made up of five individual Home Visiting Programmes, as Olds et al. (2004a) and Olds et al. (2014) were both long term follow up studies to Olds et al. (2002). The longitudinal study conducted by Olds and colleagues found that children who had received a Home Visiting Programme intervention showed significant improvements in their language outcomes relative to the control group across the first 4 years of life. However, by 72 months of age the magnitude of the difference between the intervention and control group became non-significant (Olds et al. 2014). Four studies did not find that the Home Visiting Programme significantly improved children's language development. All studies and their language outcomes are shown in Table 6. The effect sizes pertaining to child language outcomes are reported in Table 6. If a study did not report an effect size but the information provided within the published paper allowed for the post-hoc calculation of the effect size this data is reported in Table 6. Where it was not possible to calculate the effect size, 'unobtainable' is recorded in the relevant column of Table 6.

Table 6

Summary of Language Outcomes

Author	No. of children	Child age at language assessment	Language Assessment	Assessment psychometric properties	Domain of language reported	Effect Size	Summary of language outcomes
<i>Arcena et al. 2009</i>	N=79	54%, 12 months old. 46% - 12 to 15 months old.	PDS (Rodriguez, Arancibia & Undurraga, 1974). <i>Child assessment</i>	Unobtainable	Delayed language, normal language and superior language development.	Unobtainable	No significant difference between control and intervention group in frequency of language delay. A significantly higher proportion of superior language skills found amongst the children within the intervention vs control group.
<i>King et al. 2005</i>	N=513	Between 36 to 40 months old	PLS-3 (Zimmerman, Steiner & Pond, 1992) <i>Child assessment</i>	Test retest = 0.91 to 0.94 for the total Language Score. Language disorders correctly identified on average 72% of the time across the three age groups. Internal Consistency =	Total Language Score	Unobtainable	No significant difference in language score between the control and intervention group.

above 0.80 for all age groups.

<i>Nair et al. 2003</i>	N=161	6, 12 and 18 months	The REEL (Bzoch & League, 1971) <i>Parental report</i>	Average reliability coefficients for all test scores = 0.90	Receptive and expressive language ability	Expressive Language, d=0.22 Receptive Language, d=0.26	At 18 months, no significant between group difference between the intervention and control group on expressive and receptive language scores
<i>Olds et al. 2002</i>	N=560	21 months	PLS-3 (Zimmerman, et al. 1992) & PPVT-R (Dunn, 1981). <i>Child assessment</i>	PLS-3 data reported previous	Delayed, normal or superior development	Unobtainable	Nurse visited children born to mothers with low psychological resource were less likely to exhibit language delay (7%) than control group participants (18%). Intervention group children had superior language development compared to the control group
<i>Olds et al. 2004a</i>	N=605	48 months	PLS-3 (Zimmerman, et al. 1992). <i>Child assessment</i>	PLS-3 data reported previous	48 months – Overall Language score based on the PLS assessment	d=0.31	Nurse visited children born to low psychological resource mothers had significantly better language outcomes Vs control group (91.39 vs 86.73, $p=.04$).
	N=518	72 months	PLS-3 (Zimmerman, et al. 1992) & PPVT-		72 months - Overall Language	d=0.21	Nurse visited children (born to low psychological resource mothers) had significantly improved receptive language

<i>Olds et al. 2014</i>			R (Dunn, 1981). <i>Child assessment</i>	PLS-3 data reported previous	& Receptive language ability		outcomes when averaged over 2, 4 and 6 years (d= 0.3, p=.01). Between group comparisons including only the 72 month follow-up data were not statistically significant (d= 0.21, p=.16).
<i>Olds et al. 2004b</i>	N=615	72 months	PPVT-III (Dunn, 1997) <i>Child assessment</i>	Test-retest reliability = 0.91 to 0.94	Receptive language	d=0.17	Significantly higher receptive language scores found for nurse-visited children vs control (84.32 vs 82.13, p=.04)
<i>Robling et al. 2016</i>	12 months, N=1004 18 months, N=975 24 months, N=954	12 months, 18 months & 24 months old	Questionnaire (12 & 18mths) & ELM (24mths) (Coplan, Gleason, Ryan, Burke & Williams, 1982) <i>Parental assessment & Professional's incidental observation</i>	Sensitivity = 100% Specificity = 68%	Attainment of language milestones at 12 and 18 months (maternal report) and ELM assessment at 24 months	d=0.16 (at 24mth ELM assessment)	Significantly less developmental language concern in the HVP arm at 12 (adjusted OR 0.50, 95% CI 0.35 to 0.72, p<.001) and 18 months (adjusted OR 0.66, 95% CI 0.48 to 0.90, p=.009). ELM total scores at 24 months were significantly better for the intervention arm compared to the control arm (60.8 vs 55.7, adjusted difference in means = 4.49, 95% CI 0.52 to 8.45, p=.027).
<i>Sierau et al. 2015</i>	Not specified	12 months old and 24 months old	ELFRA 1 & 2 (Grimm & Doil, 2006) & The SETK-2 (Grimm,	Unobtainable	Language development score	Unobtainable	No differences in language outcomes were found between control and intervention group (β -.01 (d=-.15 - .14), WALD = .014, df=1, p=.905)

Aktas & Frevert,
2000)

Parental
assessment

<i>Schwarz et al. 2012</i>	N=269	33 months old	WPPSI-III (Gordon, 2004) <i>Child assessment</i>	Reliability co-efficients range from 0.89 to 0.95	Verbal and general Language score	d=0.02	No difference found in language outcome found between control and intervention group (90.36 (13.14 SD) vs 90.10 12.02 SD), $p=.87$)
<i>Tomlinson et al. 2016</i>	N=939	36 months old	PPVT - adapted for South Africa (Dunn, 1965) <i>Child assessment</i>	Unobtainable	<i>PPVT score</i>	Unobtainable	Children in the home visited neighbourhoods had significantly higher scores on the language assessment than children in the control group ($p=0.039$).

Why did some Home Visiting Programmes significantly improve children's language outcomes and others did not?

Frequency of home visits

The frequency of the home visits varied across each of the Home Visiting Programmes, with visits ranging from weekly to bi-annually. Table 2 shows that for many Home Visiting Programmes, the frequency of home visits varied within the programme, becoming less frequent as the child grew older. Nearly all the studies reported an average number of home visits over the course of the intervention. However, it is often unclear if the visits were evenly spaced out over time, or whether visits were sometimes clustered at certain time points (such as when the mother was in need of more support). Furthermore, within some studies the range in the number of visits varied considerably. For example, Olds et al. (2002) reported that home visits conducted by paraprofessionals ranged from 0 to 78 visits during infancy, with an average of 16 home visits. These sizable ranges in the frequency of home visits make it very difficult to draw conclusions about the impact of the frequency of home visits on children's language development.

Duration of home visits

Over half of the studies ($N = 6$) did not report the average duration of a home visit within their Home Visiting Programme (Olds et al. 2002, 2004a and 2014; Olds et al. 2004b; King et al. 2005 and Sierau et al. 2015). Of those that did report the average duration of a home visit, the time spent in the home varied considerably between programmes, from 15 minutes (Schwarz et al. 2012) to prenatal visits that lasted on average for 79.14 minutes (Robling et al. 2016). There was also considerable variation within the programmes (e.g. in Robling et al. 2016 duration of visits ranged from 30-180 minutes).

Age of the child age when their language was assessed

There was some variation in the ages at which the children's language abilities were assessed. The youngest age at which children's language ability was first measured was six months old (Nair et al. 2003), whilst Olds et al. (2014) and Olds et al. (2004b) measured children's language ability at 72 months of age in different samples. Three studies (Nair et al. 2003, Robling et al. 2016 and Sierau et al. 2015) assessed children's language development at different ages throughout their studies. A comparison of children's ages as to when the final measure of child language was taken across each of the studies did not reveal a meaningful difference as to whether the programme had a positive impact upon the children's language development or not.

Prenatal / Postnatal commencement of visits

Of the nine individual studies included within this review (Olds et al., 2004a & 2014 being follow up studies to Olds et al., 2002), seven began home visits prenatally. The two programmes to commence home visits after the birth of the child were Nair et al. (2003) and King et al. (2005). The six papers that showed a significant impact upon children's language development all commenced their home visits during the mother's pregnancy. Three studies commenced their home visits prenatally and did not find a significant outcome for language development. Two studies commenced their home visits postnatally and neither demonstrated a significant impact upon children's language development. However, it is notable that variation in sample size may partly account for this finding. For example, whilst Nair et al. (2003) did not report significant findings, the magnitude of the effect size in this study is larger than the effect size reported by Robling et al. (2016) (see Table 6) who demonstrated a significant impact of a Home Visiting Programme on offspring language development in a much larger sample.

Measures used to assess children's language development

Across the eleven studies, nine different language assessment tools were used. Some studies used more than one assessment tool, as language was assessed at several developmental stages during the home visiting and research process. The majority of studies used language specific measures to assess children's language development (Olds et al. 2002; Olds et al. 2004a and Olds et al. 2014; Olds et al 2014b; Robling et al. 2016; King et al. 2005; Tomlinson et al 2016; Nair et al. 2003 and Sierau et al. 2015). Two studies (Arcena et al. 2009 and Schwarz et al. 2012) used measures of child development that incorporated an assessment of language ability. Three studies used or partly used parental reports to supplement the direct assessment of children's language ability (Nair et al. 2003; Robling et al. 2016 and Sierau et al. 2015). The remaining studies directly assessed children's language development during one-to-one assessments. The type of measure used did not differentiate between the studies that had a positive impact on children's language development and those that did not.

Utilising a range of language assessment tools has resulted in a range of different ways to measure and analyse children's language development. For example, based on their assessment scores, Aracena et al. (2009), Olds et al. (2002) and Olds et al. (2004a) categorised children's language ability on three levels: delayed language, normal language and superior language ability. Olds et al. (2014) measured overall language scores and receptive language scores. Receptive language scores were also reported for Olds et al. (2004b), Tomlinson et al. (2016) and Nair et al. (2003). Mean length of utterance was the measure of language development used by Sierau et al. (2015), although the mean length of utterance score was not reported in this paper. A general language score was reported by King et al. (2005) and Schwarz et al. (2012). Robling et al. (2016) assessed children's language ability using the ELM that included an interview between the parent and assessor

which incorporated the assessor's observations of whether the child met specific language milestones or not.

Discussion

Using the inclusion criteria to screen the studies identified during the systematic literature search, 11 empirical studies were included in the current analysis, two of which were long term follow-up studies of the same sample. Therefore, a total of nine individual Home Visiting Programmes were found to have used a randomised control trial design and met the inclusion/exclusion criteria. Six of the eleven individual papers included in this review reported a significant difference in the language development of children whose mothers' received the Home Visiting Programme compared to the comparison group. Where sufficient statistical data was reported, it is evident that the magnitude of the difference between the intervention and control groups represents a small effect size. These findings give grounds to suggest that Home Visiting Programmes do have a potentially small, yet measurable positive impact on children's language development.

Though this is a tentative conclusion, it appears that the earlier a Home Visiting Programme engages and supports the mother (ideally during pregnancy), the more likely the programme will be to have an impact upon the child's language development. This is supported by Peacock et al. (2013) who concluded that Home Visiting Programmes that approach mothers prenatally achieved the greatest effectiveness overall across a range of offspring outcomes. All of the studies included in this review that found a significant difference in children's language development began prenatally. In contrast, both of the studies that began postnatally did not find a significant difference in offspring language development. It is important to highlight that variation in the sample sizes of the included studies could partly explain why Home Visiting Programmes that began during pregnancy appear to produce the greatest benefit. Nevertheless, these findings give grounds to suggest that services looking to implement Home Visiting Programmes should commence their visiting during pregnancy.

The prenatal onset of the Home Visiting Programme might give the intervention the best chance to make a positive difference to children's language outcomes (and potentially other domains of development) for a number of reasons. A healthy change in maternal behaviour during pregnancy (e.g. reducing alcohol consumption or smoking) would likely have a positive impact upon foetal development which in turn positively impacts upon the child's language development (McGee et al. 2009). The prenatal onset of the Home Visiting Programme also allows more time for the development of a therapeutic relationship between the mother and the home visitor which could increase the mother's receptiveness to the home visitor's recommendations and support postnatally. The Interactionist Theory of language acquisition (Bruner, 1983) states that children's learning of language is dependent upon a desire to communicate with the world and the social interaction they experience. It therefore follows that if Home Visiting Programmes are able to engage mothers from a very early stage and facilitate an improvement in the quality and frequency in which mothers interact with their children (i.e. straight from birth), the increase in social interaction and verbal communication between mother and child will likely lead to an enhancement in the speed and ability of a child developing their language skills.

Prenatal support may also help promote the mother's early attachment to her baby, resulting in a closer relationship postpartum that fosters children's subsequent language development. For example, Vidrine-Isbell (2017) posits that human bonding is central to language acquisition in infants, as well as in adults. If the prenatal Home Visits are able to help establish and enhance the bond that the mother feels towards her baby, then this could lay strong foundations for language acquisition as the attachment grows and the child develops. Similarly, Tamis-LeMonda and colleagues (2014) discuss how maternal responsiveness plays an important role in children's language development. If prenatal intervention is able to promote foetal attachment and mother's responsiveness skills, then it is

possible that this could go some way towards explaining why Home Visiting Programmes that begin during pregnancy positively impact upon children's language development. Future evaluations of Home Visiting Programmes should measure prenatal attachment and the quality of mother-infant interaction postpartum in order to help identify the intervention mechanisms that foster children's language development.

The fact that half of the studies did not report the duration of the home visits within their programme makes it challenging to compare the impact of visit duration on programme outcomes. Whilst the studies reporting the longest average duration of visit (Arcena et al 2009 and Robling et al. 2016) found positive language outcomes, and the programme with the shortest average duration of visits did not (Schwartz et al. 2012), the degree of variation in visit duration within each programme means this pattern should be noted with caution. There are a number of reasons why the duration of home visits may play a role in children's language development. A longer home visit is likely to help in the development of the rapport between mother and home visitor, building increased trust and confidence in their support and advice. Longer home visits also enable the home visitor to offer more support and guidance to the mother around parenting skills and promoting children's development. Therefore, in order to understand the impact of duration and "dose", it is recommended that these data, along with other markers of fidelity should be consistently measured and reported by Home Visiting Programme practitioners and researchers. In addition, it is recommended that future evaluations of Home Visiting Programmes need to report on the content of the visits and measure the different components of the intervention (*including the quality of the therapeutic alliance between the home visitor and parent*) to help determine *why* a given programme was effective.

An additional challenge when assessing language development is the array of language domains that can be measured. For example, language assessments can look at

phonology, pragmatics, syntax, semantics and morphology (Yoshinaga-Itano, 1997). As a result, a wide range of language assessment tools have been developed, each one measuring one or more domains of an individual's language capabilities. This review highlights the wide array of language assessment tools that are used to measure the range of domains that comprise children's language development. Future research in this area might wish to review the language assessment tools used by studies of a similar nature so as to develop a core set of language outcomes that would aid the comparison of outcomes across studies.

An additional, yet important consideration when taking into account the outcomes of Home Visiting Programmes is the level of health and social care available to individuals within the country. That is, when the control group receives little to no care or intervention, the impact of a Home Visiting Programme is likely to be much greater than when a usual care control group involves an individual having access to well-funded, easily accessible health and social care services. This observation has been put forward by Robling and colleagues (2018) as an explanation as to why the Family Nurse Partnership programme evaluations in the USA achieved greater overall results (Olds et al., 2002; Olds et al., 2004b) than the UK evaluation (Robling et al., 2016).

Overall, this review is constrained by the articles that were retrieved through the database search. Though a thirty-year publication period was used as part of the search criteria, it is possible that relevant studies had been published before 1990 and were therefore not included in this review. Studies included in this review were also limited to those published in the English Language, thereby excluding potentially relevant studies written in other languages. It is also possible that additional studies have been published within electronic databases not searched as part of this systematic review. However, a hand search of the reference lists of relevant studies was conducted in order to minimise this risk as far as possible. Furthermore, the search strategy specified studies that made reference to synonyms

of the word 'language' in their title and / or abstract. It may be the case that some studies were not identified by the search strategy as 'child development' was used as an umbrella term in the title or abstract, under which language was discussed in the main text. Although almost 5000 articles were retrieved during the search strategy and the search term '*home visit**' likely identified the majority of relevant studies published in the English language.

The findings and conclusions of this review need to be considered in light of the potential for publication bias, selective reporting within studies, and the methodological limitations of the included studies. This latter limitation is somewhat addressed by the inclusion of a quality assessment of each included study which enables the identification of risks/biases. Given that the Home Visiting Programme model has been set up in countries all over the world, and that language acquisition is a vitally important developmental milestone, it was surprising to find that children's language development is not widely assessed and/or reported on as a programme outcome. This observation could be a reflection of the complexity that assessing child development presents. With so many domains and potential outcomes of child development for researchers to focus on, language development may be overlooked. The challenges that present when assessing children's language skills, including identifying an appropriate language assessment are known (Dockrell, 2015), and may be a reason this domain of development is overlooked as an outcome. Future evaluations of Home Visiting Programmes are strongly urged to consider the assessment of children's language development as an outcome measure. A potential solution to this could be for future research in this area to include speech and language specialists within the research and intervention team to advise on and / or assess children's language development.

One limitation of this review is that the data extraction process was conducted by a single reviewer, therefore opening up the possibility of human error in the data extraction process. A second limitation is that the search strategy did not overcome the *'file drawer*

problem' as a detailed search of the grey literature was not conducted. As such, it is possible that the positive impact of Home Visiting Programmes on children's language development are overstated in the current review. Furthermore, few evaluations of Home Visiting Programmes have examined the longer term impact on children's language development beyond early childhood. For example, of the included studies N= 4 stopped at 24 months and N = 6 by 36 months. Only two studies followed children up beyond 36 months (Olds et al. 2014; and Olds et al 2004b). It is noteworthy that this review only included studies using an RCT design and as such, it is possible that evaluations of Home Visiting Programmes that used a different methodology (*e.g. a cross-sectional or longitudinal study design*) may reveal the long term impact on children's language development. It is also worth considering that as this review has focussed specifically on language outcomes, included studies may represent a particular subgroup of Home Visiting Programmes.

Given that most Home Visiting Programmes target similar populations (vulnerable / socially at-risk mothers), the results and conclusions of this review will be generalizable to many existing and future Home Visiting Programmes. The fact that the target populations are similar in several ways across Home Visiting Programmes is a key strength to the research and development of these programmes. Current and future Home Visiting Programmes should consult with the evidence base and look to incorporate it into their practice, both in terms of children's language development and wider outcomes. Furthermore, future evaluations of Home Visiting Programmes would benefit from considering how the length of the home visit and the dose / duration of each visit impacts upon programmes outcomes. Although it was difficult to draw a firm conclusion, the results of this review highlight the need to identify the most appropriate 'dose' to ensure that the support offered by the Home Visiting Programme is sufficient and meeting the needs of the mothers and their children. This conclusion is supported by Peacock et al. (2013).

Visits that are too short are unlikely to allow the home visitors enough time to impart their knowledge to the mothers and are therefore perhaps unlikely to achieve the best possible outcomes—both in terms of the child’s development and maternal outcomes. This is supported by a meta-analysis of Home Visiting Programmes by Nievar and colleagues (2010) who concluded that the effectiveness of Home Visiting Programmes is primarily dependent upon the intensity and frequency of the services provided to the family. Further support for longer visits producing more favourable outcomes is provided by Gomby and colleagues (1999) and Holzer and colleagues (2006). Future commissioned services need to ensure that their Home Visiting Programmes are supported by the evidence base to ensure a ‘goldilocks’ dose of visiting; not too long, not too short, but just right. The findings of this review also indicate that Home Visiting Programmes that begin during pregnancy are most likely to translate into improvements in children’s language outcomes. Future evaluations of Home Visiting Programmes need to examine the mechanisms of the intervention effect in order to inform improvements in service delivery and maternal and child outcomes.

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Supplementary Tables 3 and 4

Table 3

Overview of the aims of each Home Visiting Programme

<i>Study</i>	<i>Support the mother</i>	<i>Child's development</i>	<i>Improve family Health</i>
<i>Arcena et al. 2009</i>	X	X	X
<i>King et al. 2005</i>	X	X	X
<i>Nair et al. 2003</i>	X	X	X
<i>Olds et al. 2002, 2004a, 2014</i>	X	X	X
<i>Olds et al. 2004b</i>	X	X	X
<i>Robling et al. 2016</i>	X	X	X
<i>Sierau et al. 2015</i>	X	X	
<i>Schwarz et el. 2012</i>			X
<i>Tomlinson et al. 2016</i>		X	X

Table 4

Summary of each Home Visiting Programmes targeted aims, control group support and home visitor guidelines.

Author	Targeted aims of the Home Visiting Programme
<i>Arcena et al. 2009</i>	<ol style="list-style-type: none"> (1) Development of mothers identity (2) Develop mothers life plans (3) Reinforce her parenting skills (4) Promote basic health care practices for both mother and child (5) Strengthen the adolescent's relationships with those around her.
<i>King et al. 2005</i>	<ol style="list-style-type: none"> 1) Teaching parents about child development 2) Role-modelling parenting skills 3) Linking families to a medical home
<i>Nair et al. 2003</i>	<ol style="list-style-type: none"> 1) Increase maternal empowerment to manage problems (substance related and other) by linking with other services, family and social supports. 2) Promote child development by teaching mothers how to interact with their children.
<i>Olds et al. 2002, 2004a, 2014</i>	<ol style="list-style-type: none"> 1) Improve maternal and foetal health during pregnancy 2) Improve the health and development of the child after birth 3) Enhance parents' personal development (future pregnancies, education, employment).
<i>Olds et al. 2004b</i>	<ol style="list-style-type: none"> (1) Improve pregnancy outcomes by promoting women's healthy prenatal behaviours (2) Improve the health and development of children by promoting parents' competent care of their children (3) Enhance parents' life-course development by encouraging parents to plan subsequent pregnancies, complete their education, and find work.
<i>Robling et al. 2016</i>	<ol style="list-style-type: none"> 1) Improve pregnancy outcomes 2) Improve child health and development 3) Improve parents' economic self-sufficiency.
<i>Sierau et al. 2015</i>	<ol style="list-style-type: none"> 1) Improve family environment such as quality of home, access to social support 2) Improve maternal self-sufficiency, maternal empathy and parenting skills 3) Support child development
<i>Schwarz et al. 2012</i>	<ol style="list-style-type: none"> 1) Increase participation in child primary health care services 2) Promote participation in early intervention programs
<i>Tomlinson et al. 2016</i>	<ol style="list-style-type: none"> 1) Reduce mother's risk of acquiring HIV 2) Prevent Maternal to Child Transmission 3) Improve maternal and child health including TB and illness detection 4) Reduce maternal alcohol use 5) Improve infant and child nutrition 6) Foster children's growth and development.