The Impact of the Family Start Home Visiting Programme on Outcomes for Mothers and Children

A Quasi-Experimental Study

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Disclaimer

Note on Random Rounding

All counts presented in this study have had Statistics New Zealand confidentiality rules applied. This includes the random rounding of all counts to base 3. Therefore, the sample counts presented are not exact, and in some cases aggregating sub-samples will not yield the exact population counts.

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Executive Summary

Family Start is a voluntary, intensive home visiting programme available to pregnant mothers and families with pre-school children which operates in selected regions of New Zealand. The programme targets families with children at heightened risk of adverse outcomes and aims to improve their health, education and social outcomes. Families are generally enrolled prior to their child's first birthday and remain in the programme until the family "graduates" or the child reaches school age.

Family Start workers make regular home visits and, using a structured programme, seek to improve parenting capability and practice. Workers also actively connect families to other agencies and services that aim to improve children's health and early childhood education participation and the family's circumstances.

Family Start was first introduced in 1998 in 3 sites and rapidly expanded in 1999 and 2000 to 13 more sites. It was enhanced and expanded to encompass 14 new areas between 2005 and 2007. While this expansion substantially increased access, not all of the country is covered and some regions have no access to Family Start.

The only other intensive early intervention home visiting programme funded at the same scale in New Zealand is Early Start which operates in parallel to Family Start, serving the Christchurch region. In contrast to Early Start which has been evaluated in a randomised controlled trial, Family Start has never been evaluated in a manner that could establish its effectiveness in improving outcomes.

This study uses rich linked administrative data for children born from 2004-2011 and undertakes an impact evaluation using two separate quasi-experimental methods (propensity score matching at the individual level and area-level fixed-effects regression at the community level). The phased and incomplete expansion between 2005 and 2007 provides variation in exposure to the programme and is used as the basis for quasi-experimental estimation of programme impacts.

We summarise the outcomes of interest for this evaluation and the principal findings in the sections below.

Impacts on Mortality

Infant mortality rates are high in New Zealand compared with other OECD countries. Rates of Sudden Unexplained Deaths in Infancy (SUDI) are especially high, particularly for Māori infants.

The most striking finding from our study is robust evidence that Family Start reduced post neonatal infant mortality. The evidence of programme impacts is strongest and most persuasive in the case of SUDI and injury deaths.

These mortality results are consistent with emerging evidence from other home visiting studies. Due to the rarity of these death events, the point-estimate of effect size should be treated with caution, thus we use the 95% confidence interval when discussing programme impact.

Family start is estimated to have reduced post neonatal SUDI by between 0.6 and 1.6 deaths per 1,000 children who received Family Start born between 2009 and 2011 compared to a matched control sample who were similar in underlying characteristics, but lived in areas where Family Start was not available.

Estimated mortality effect sizes are larger for Māori children with an estimated effect on post neonatal SUDI in the range of 1.5 to 4.3 per 1,000 children receiving Family Start. Estimated mortality effects for Pacific children were slightly smaller than those estimated for Māori – with statistically significant impacts on both post neonatal SUDI and infant injury deaths. Results suggest that the expansion of the Family Start programme may have accounted for some of the narrowing in ethnic disparity in infant mortality that occurred over the study period.

Impacts on Early Childhood Education and Health Service Engagement Service Utilisation

Results suggest that Family Start had positive impacts on families' utilisation of some health services, and increased children's engagement with early childhood education. We estimate that Family Start: (i) increased the likelihood that children were fully immunised in their first 2 years; and (iii) increased participation in early childhood education at age 4.[1]

We find some evidence of increased maternal utilisation of non-addiction mental health services in the first year following the child's birth. In overall results, we cannot rule out the possibility that an apparent increase in addiction service utilisation was due to reverse causality where mothers using these services were referred to Family Start (rather than Family Start initiating service engagement). However for Māori children there is more convincing evidence that increased maternal utilisation of addiction services resulted from engagement with Family Start. For Pacific, there is some evidence that increased maternal utilisation of non-addiction mental health services in the second year occurred as a result of Family Start.

We find no statistically measurable impact, either positive or negative, on participation in the B4 School Check. A concerning finding is an estimated reduction in enrolment with a primary health organisation at age 1 (although by the second year enrolment rates have caught up – and in the case of Māori exceeded the enrolment rates amongst the control group). The reduction in PHO enrolment found at age 1 warrants further investigation outside of this study.

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[1]Early childhood education participation was only observed for those families who took part in the voluntary B4 School Check.

Impacts on Child Youth and Family Contact and Maltreatment Marker Injuries

Another finding from this study is an increase in the rate at which children who were engaged with Family Start were brought to the early attention of Child Youth and Family (CYF). Our results suggest that an increased rate of notification is likely to have also led to increases in the proportion of children with substantiated findings of maltreatment. The magnitude of this effect is difficult to establish given the short follow-up. Many of those in the control group might have eventually come into contact with CYF. Additionally, while the control group was similar to the group of children who received Family Start on most characteristics, they were more likely to be in a family where other children had previously come to the attention of CYF and this, rather than participation in Family Start, might explain some of the estimated difference in contact with CYF. Finally, some children entered Family Start as a result of earlier CYF involvement resulting in "reverse causality" inflating some estimated effects.

We also looked at whether Family Start had an impact on hospital admissions that are coded as maltreatment-related or are for injuries that are considered "markers" for maltreatment. For the sample as a whole, the results on admissions are inconclusive. There is some ambiguity in interpretation of an absence of a reduction in these measures. Underlying injury rates may have been reduced, but rates of hospitalisation might have appeared unchanged as a result of more families seeking treatment for children's injuries as a result of Family Start.

Our analysis mainly focuses on the immediate effect of Family Start for the mother and child who received the service. These sorts of programmes often have substantial spill-over effects to subsequent births or other family members. We do find some suggestion of spill-over effects in the community level analysis – and it is useful to keep this possibility it mind.

By the nature of our data, we are restricted to examining outcomes that are captured in administrative records. Administrative data currently offer few direct measures of children's cognition, parenting behaviours and attitudes, or the home environment. This means that our study captures only a subset of programme impacts that are of interest.

Conclusion

Evidence from small randomised controlled studies has previously shown beneficial effects of intensive home visiting services offered in pregnancy and early childhood years to families whose children are at risk of adverse outcomes. This study confirms that some of these benefits are scalable – suggesting that home visiting ought to be a central component of efforts to improve outcomes for vulnerable families.

The most promising finding from this study is the reduction in post neonatal mortality, an outcome that signals improvements in children's environment and care.

The finding of an increase in CYF contact accompanied by a reduction in mortality has important implications for both evaluation and monitoring of programmes that serve vulnerable families. Evaluation or provider monitoring protocols that restrict attention to only CYF outcomes might make erroneous conclusions about the benefits of the intervention. This suggests that (i) a broad suite of outcomes are needed in both evaluation and monitoring of services to ensure accurate assessment of impacts; and (ii) that where possible evaluation studies should be powered (i.e. have large enough samples or sufficiently long follow-up periods) to enable rare but important outcomes such as improved survival to be observed.

While beyond the scope of the current study, estimated impacts such as the reduction in mortality, increased early childhood education participation and increased immunisation could be combined with a simulation of programme impacts in later childhood and information on the direct and indirect costs of the programme to conduct a cost-benefit or cost effectiveness analysis. Such an analysis would inevitably be limited by the outcome data available for study at present, but could allow high-level comparison of Family Start with other programmes and services designed to achieve similar outcomes, and inform an assessment of the benefits of further expansion of the programme toward increased national coverage, and increased capacity where demand outstrips supply.

We recommend that any future expansion of Family Start be accompanied by a strong evaluation strategy that ensures impacts on the wellbeing of children and their parents can be demonstrated, ongoing programme innovations have evidence for effectiveness, and between-site variation in effectiveness is monitored and evaluated. Future studies would be strengthened if they include both administrative measures of programme efficacy and direct measures of improved wellbeing, home environment and parenting practice based on interviews with families.

1. Introduction

Mounting evidence that disadvantages in the early years have long term impacts on health, economic wellbeing and other outcomes (Almond and Currie, 2011) has occurred in parallel with a growth in funding for programmes designed to ameliorate poor starts to life. Home visiting programmes where nurses, social workers or para-professionals visit "at risk" mothers and children at home and deliver a range of services are growing in importance. Home visiting is considered a central pillar of improving outcomes for at risk children in the United States (Glied and Oellerich, 2014) and expansion of home visiting programmes has also occurred in the United Kingdom and New Zealand.

The focus on these programmes stems from a growing body of evidence showing that intensive home visiting programmes in pregnancy and early childhood can improve parenting practices and have positive impacts on child health, school readiness and adjustment in adolescence (Robertson, 2014; Avellar et al., 2014; Howard and Brooks-Gunn, 2009; Peacock et al., 2013), and that even if only some of the adversities facing at-risk children are averted, the return on investment from effective early intervention programmes can be substantial (Kilburn and Karoly, 2008).

In a small number of studies, home visiting programmes have been shown to be effective in reducing child maltreatment (MacMillan et al., 2009; Robertson, 2014; Avellar et al., 2014; Howard and Brooks-Gunn, 2009). In the Elmira trial of the Nurse Family Partnership, intervention group children had less restriction and punishment, fewer substantiated reports of abuse, and fewer maltreatment reports at 15 years of age (Olds et al., 1986; Olds et al., 1997). Intervention families in the Early Start trial in New Zealand, discussed in more detail below, had more positive and less punitive parenting and lower rates of parent reported childhood physical abuse (Fergusson et al., 2012).

Home visiting is also a promising means of reducing child mortality. In the Memphis Nurse Family Partnership trial, home visiting for very low-income first-time mothers reduced all-cause mortality in mothers and preventable cause mortality to age 20 in children (Olds et al., 2014). A quasi-experimental study of a community implementation of the Nurse Family Partnership found participation in the programme reduced the frequency of adverse perinatal outcomes, including infant mortality, for first-time single mothers (Carabin et al., 2005).[2]

The evidence of the effectiveness of these programmes, however, is not universal. A number of programmes and implementations have been found to have no effect

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[2] The promise of home visiting in this respect is reinforced by new evidence on the mortality effects of introduction of nurse home visits on a universal basis. Fixed effects area-level study of introduction of a universal nurse home visiting programme for Danish mothers and their infants from 1937 through 1949 found reduced infant mortality (Wüst, 2012).

(Avellar et al., 2014; Gomby, 2000; Peacock et al., 2013; Robling et al., 2015; Olds, 2015) and many do not have robust studies of their effectiveness (Avellar et al., 2014). Furthermore, virtually all of the available evidence comes from studies conducted in the US.[3] Evidence supporting home visiting programmes tends also to come from small-scale studies that are not typically large enough to establish impacts on low probability events (Olds et al., 2014), and they rarely allow for analysis of effectiveness for ethnic sub-populations (Avellar et al., 2014).[4]

There is a very limited and mixed evidence base for programme effectiveness once home visiting is implemented at scale in community settings (Rubin et al., 2011; Matone et al., 2012; Carabin et al., 2005; Robling et al., 2015; Olds, 2015). Developments in the availability of de-identified linked administrative research data from across health, education and social services are expanding opportunities for research and programme evaluation (Brownwell and Jutte, 2013; Currie, 2013; Matone et al., 2013). They more readily allow the study of low probability events and examination of outcomes for different sub-populations of interest, and provide opportunities for relatively low cost examination of outcomes observed across multiple systems and domains (Putnam-Hornstein et al., 2013).

This paper builds on this growing use of administrative data to undertake an impact evaluation of the Family Start home visiting programme in New Zealand. Family Start is a voluntary, intensive home visiting programme designed to improve health, education and social outcomes for children, and to improve parents' parenting capability and practice, and personal and family circumstances. A phased and incomplete expansion of the programme is exploited to provide variation in exposure.[5] We utilise two quasi-experimental evaluation methods to ensure that our results are robust to methodological choices. These are area-level fixed-effects regression and propensity matching at the level of the child.

The rest of the paper is organized as follows. Section 2 provides more detail on the Family Start programme. Section 3 discusses the data and describes the core outcomes used in the analysis. Section 4 motivates and explains the two methodologies used in the paper. Section 5 discusses the main results, and section 6 discusses the limitations of this analysis. Section 7 provides a discussion of relevance for the current delivery of the Family Start programme, and section 8 concludes.

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[3]In a recent review, the New Zealand Early Start programme was the only non-United States programme assessed as meeting the criteria for an evidence-based early childhood home visiting service delivery model with evidence for effectiveness (Avellar et al., 2014).
[4]The randomised controlled trial of Early Start (Fergusson et al., 2012) is a notable exception.
[5]This evaluation is restricted to those communities that were part of the expansion of the enhanced Family Start programme commencing in 2005.

2. Family Start

2.1 The Family Start Programme

Family Start (hereafter FS) is one of the government's principal early intervention services aimed at helping support vulnerable families to achieve better outcomes. FS is designed to assist the families in the population whose children are most at risk of poor outcomes. Iwi[6]-based Māori service providers and Pacific, faith-based and other health and social service organisations deliver the service to families in accordance with a programme manual,[7] and in a manner that is culturally responsive to their communities. Children are generally enrolled either before birth or in their first year,[8] and can remain in the programme until the family "graduates"[9] or the child reaches school age. An analysis of 2009 data conducted by MSD found that a third of new FS children were enrolled in the antenatal period and three quarters were enrolled before six months of age. In common with other programmes operating at scale (O'Brien et al., 2012; Ingoldsby et al., 2013), attrition was relatively high. One in four left the programme in an unplanned way within six months of enrolling (MSD, 2009).

Details of the programme to be delivered are specified in a contract for service with providers. Providers are funded to deliver a home visiting service at varying levels of intensity (and either weekly or fortnightly home visits) depending on the family's needs. An individualised family plan is developed and regularly revised, and this forms the basis for the services and support provided. Programme manuals provide guidelines for the resourcing of FS programmes. For instance, the 2009 manual suggested a ratio of 1 worker to 16 families (FaCS, 2009). A central programme component is the child development and parent education curriculum entitled Āhuru Mōwai/Born to Learn. This curriculum is derived from the Parents as Teachers home visiting programme with an additional New Zealand cultural component (Robertson, 2014; MSD 2009).[10] Figure 1 provides the programme logic for FS.

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[6]Iwi are indigenous Māori tribal groups.
[7]See CYF, 1999; FaCS, 2009; FaCS, 2012; Community Investment, 2015.
[8]With provision to accept later enrolments in exceptional cases (MSD, 2009).
[9]Graduates are formally discharged by the service provider based on the completion of the programme. There appears to be some ambiguity in how each provider interpreted this with some providers rarely graduating families.
[10]The curriculum incorporates: (i) neuroscience, child development and parenting information from a western perspective; (ii) Āhuru Mōwai, developed from traditional Māori beliefs and practices about child-rearing and drawing on Te Whāriki, New Zealand's early childhood curriculum; and (iii) month-by-month practical information with a Māori culture and language focus (Robertson, 2014).

Figure 1: Programme Logic[11]

Activities ↓	FS workers: - engage families and conduct regular home visits - work in partnership with families to achieve their goals and improve outcomes for the child - develop and regularly review individualised family plans - promote access to and use of child health services and early childhood education - deliver the ĀhuruMōwai/Born to Learn curriculum - provide caregivers with social, emotional and practical support - support caregivers to ensure babies are breastfed, reduce hazards in the home and keep the home smoke-free - support caregivers to address family violence, substance abuse, mental health, housing, income support, budgeting and other difficulties - work collaboratively with other agencies to address families' needs and promote access to services - move families to greater independence by promoting improved confidence and connectedness with family/whānau and community - report to CYF where there are concerns about child abuse or neglect
Short-medium term outcomes ↓	FS increases the likelihood that: - Well Child/Tamariki Ora health checks are completed - children are registered with a primary health care provider - children are registered with an oral health practitioner - immunisations are up to date - babies are breastfed - homes and cars are smoke free and free of hazards - children are healthy, physically safe and not maltreated - children participate in early childhood education - caregivers have an understanding of child development and provide warm, sensitive, consistent and competent care for their children - family violence and alcohol and drug misuse that impacts on children is identified and addressed - depression and other mental health problems are identified and addressed - families have stable housing and basic needs are met
Ultimate outcomes	- children's health, education and social outcomes are improved - parenting capability and practice are improved - parents' personal and family circumstances are improved

[11]This Programme Logic was developed by the authors and informed by a draft intervention logic developed in 2007 (MSD, 2007) and the 2009 programme manual (FaCS, 2009). A Theory of Change model was introduced to FS in July 2015 (Community Investment, 2015).

FS was first introduced in 1998 in 3 pilot sites and rapidly expanded to another 13 sites in 1999 and 2000. Enhancement of the programme and a second expansion occurred in phases between 2005 and 2007. By the end of 2007 FS was operating in 30 out of the country's 74 city and district council areas ("Territorial Local Authorities" or TLAs).[12] There has been no further expansion of the programme since that time.

Core features of the FS programme have been in place since its inception. However the emphasis, targeting, monitoring, and contract management of the programme have all evolved over time (see Appendix A for a detailed description). From 2005, there has been an expectation that FS workers will have a formal tertiary qualification in social work, nursing or early childhood education.[13] Regular monitoring reports have been required on indicators relating to programme delivery such as frequency of visits and the ethnic composition of the client caseload relative to that of FS workers. Additionally, a suite of outcome measures including immunisation, Well Child/Tamariki Ora health check completion, breastfeeding, and registration with a primary health provider are monitored. A small number of national office and regional staff in MSD administer the programme, provide training and monitor contract performance.

A 2009 review confirmed that FS had many of the design features needed for an effective early intervention service, but highlighted variation in performance across providers and pointed to improved contract management as a means of addressing poor performance and exiting poorly performing providers. It recommended that once programme fidelity increased and an evaluation was undertaken to show the effectiveness of service delivery at the local level, the Government should consider increasing volumes at site level and expanding the number of sites operating around the country (Cribb, 2009). This review informed changes to the programme which were implemented in 2011 and 2012.

2.2 Family Start and Early Start

In addition to FS, New Zealand has another long-standing home visiting programme – Early Start – which serves the Christchurch area and is funded from the same funding source as FS. Early Start is not part of the present evaluation but it may be useful to briefly review the relationship between Early Start and FS.

Initial programme design for FS was based on the Early Start pilot, which had adapted the Healthy Start Hawaii programme to the New Zealand context (Irvine, 2003; Fergusson et al., 2012). Early Start was developed by a consortium of Christchurch Health and Development Study researchers and Christchurch service providers in the mid-1990s, partly in response to research which showed strong linkages between

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[12]TLAs range from small provincial centres and their surrounding rural areas (with populations numbering in the thousands) to large urban centres (with populations numbering in the hundreds of thousands). In most cases, FS service boundaries map to 2006 TLA boundaries.
[13]Study awards were introduced at that time to support FS workers to obtain these qualifications.

exposure to a multiple problem family environment and multiple adjustment problems in adolescence in the Christchurch Health and Development Study birth cohort. Young people reared in the most disadvantaged 5% of the study cohort had rates of severe maladjustment that were over 100 times the rates for young people in the most advantaged 50% of the cohort (Fergusson et al., 1994). Providing at-risk families with direct support with parenting, child rearing and life skills was seen as a potential means of addressing the difficulties and stresses faced by children from severely disadvantaged home environments, and reducing downstream childhood and adolescent problems (Fergusson et al., 2012).

Early Start was piloted, and then evaluated using a randomised controlled trial. Initial evaluation of the programme showed Early Start had small to moderate positive impacts on outcomes for children. Positive impacts included higher rates of contact with general practitioners and Well Child services; lower rates of hospital attendance for accidental injuries; greater utilisation and uptake of early childhood education and dental services; lower rates of parental reports of child abuse; higher rates of positive and non-punitive parenting; and lower rates of childhood behavioural problems (Fergusson et al., 2005). In a subsequent evaluation examining outcomes out to 9 years, Early Start continued to have small positive impacts on outcomes for children. An important finding was that effects were similar for children in Māori and non-Māori families. Achieving change for parents proved more difficult. No statistically measurable programme impacts were found for maternal depression, parental substance use, family violence, family economic circumstances, parental separation or conflict (Fergusson et al., 2012). Early Start demonstrated that home visiting programmes can be effective in improving children's outcomes in the New Zealand context.

FS, at its inception, was similar to Early Start in that both offered family support and home visitation by family support workers to high-risk families (Irvine, 2003). However, "[t]he differing history has led to differences in emphasis. Early Start, initially created as a randomised control trial programme, maintains a strong link to research, has set benchmarks for itself and focuses on consistent delivery and 'fidelity' to the programme design. Family Start developed from the Government's Strengthening Families Strategy and focused on contracting appropriate providers and localised responses, while also identifying key aspects that needed to be delivered" (Cribb, 2009: p6). In contrast to Early Start, FS has never been evaluated in a manner that could establish its effectiveness in improving outcomes (Cribb, 2009; Robertson, 2014) — a gap this evaluation hopes to fill.[14]

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[14]Early Start was not able to be examined as part of the present study. Early Start participation data is not recorded on the same system as FS and could not be included in the study of individual-level impacts. In addition, the introduction of Early Start pre-dated the period over which we were able to study the impacts of programme phase-in at the community-level.

2.3 Expansion of Family Start

Since we exploit the phased expansion of the FS programme, it is important to outline its timing. Since FS is (in most cases) contracted at the TLA level, expansions have occurred at this level, with new providers being contracted to commence enrolling pregnant women and babies born to mothers residing in additional TLAs. As mentioned above, FS has been continuously available in 16 TLAs since prior to 2001 (together with the Christchurch TLA served by Early Start, these comprise "treated pre-2001" TLAs). Of the remaining TLAs, 44 were never selected to participate in the FS programme, and never received Early Start ("never treated" TLAs). FS was newly introduced in 14 TLAs between 2005 and 2007 ("phased-in" TLAs).[15] The geographic distribution of FS and Early Start by the timing of introduction is shown in Figure 2.[16] More details on the expansion and the comparability of treated and untreated areas are provided when we discuss the methodology in section 4.

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[15]Refer to Appendix A for additional detail.

[16] While in most cases, contracted service boundaries map to TLA boundaries, there are some exceptions not reflected in Figure 2 where the provider for a TLA is also contracted to serve a small part of a neighboring TLA. Where a relatively high proportion of children in such a neighboring TLA receive FS, we exclude that TLA from the set of "never treated" areas used in the analysis.

Figure 2: TLAs served by FS and Early Start (Christchurch)
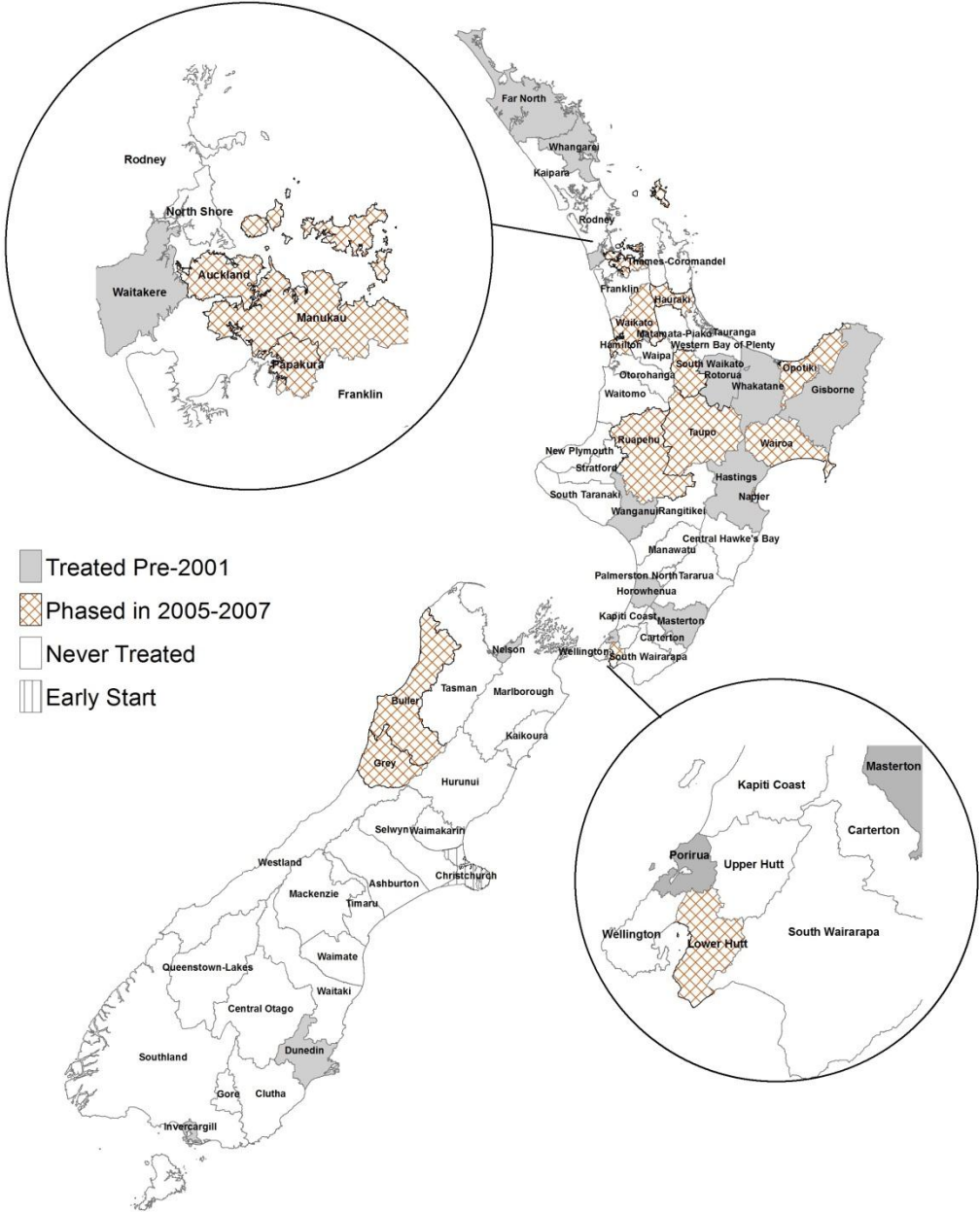
3. Data Sources and Outcomes

3.1 Linked Administrative Data

This analysis relies on rich linked administrative data for cohorts born mid-2004 to end-2011. Health records (from national maternity, mortality, immunisation, B4 School health check, hospitalisation, primary health organisation (PHO) enrolment, and community-based mental health services collections) were linked within the Ministry of Health (MoH) using the National Health Index, a unique identifier that is assigned to every person who uses health and disability support services in New Zealand. Health records were then linked with records from across other administrative systems (birth and death registries, welfare benefits, the Child Youth and Family (CYF) child protection system, the Department of Corrections sentencing system and FS). This was done probabilistically using first name, last name, birth dates and other potentially identifying variables. Appendix B provides more detail on the data linkage and clerical checks on accuracy. Data were de-identified prior to analysis, and accessed by the research team through the secure Statistics New Zealand Data Lab and a secure server at MSD. Ethics approval was granted by the Central Health and Disability Committee (Reference 14/CEN/95).

The study population comprises all live born children whose births were recorded in maternity data where the birth dates fell between 1 July 2004 and 31 December 2011 (inclusive). Births in maternity data are identified either as a result of (i) a lead maternity carer's claim for payment; or (ii) a publicly funded hospital event. Because maternity services in New Zealand are publicly funded and provided universally free of charge, these data capture almost all births.

Adults and other children are linked to children in the study population using available administrative data on family relationships. A mother is able to be linked to the child in virtually all cases using maternity data. A father or second same-sex parent is identified if named in the birth registration record.[17] Other children cared for by mothers supported by welfare benefits at around the time of the birth event or in the 5 years prior are identified using welfare benefit records. These children could include both siblings and unrelated children. Birth registry and maternity data were only available in the linked data studied from 1 July 2004. This meant that siblings could not be comprehensively identified for remaining families.

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[17]New Zealand birth registrations allow the father or second same-sex parent to be unnamed.

3.2 Outcomes

Using data for each child, mother, father, and for other linked children we derive a range of variables. Detailed definitions are listed in Appendix C. Outcome variables are grouped under three broad domains which link to the programme logic (Figure 1): Early Childhood Education and Health Service Engagement; Maltreatment Marker Injuries and CYF Contact; and Child Mortality.[18] We now discuss each of these in detail.

Outcomes: Early Childhood Education and Health Service Engagement

An important part of the FS service is to link families to preventive health services, early childhood education, and other services that can improve health, education and well-being of the child and family. We construct seven indicators of such engagement. These are:

i. Maternal use of publically funded addiction services in the first and second year following the birth of the child;
ii. Maternal use of publically funded non-addiction mental health services in the first and second year following the birth of the child;
iii. Enrolment of the child with a primary health organization (PHO) at age 1 and at age 2;
iv. Being fully immunised at one or more milestone age up to 12 and 24 months;
v. Being fully immunised at every milestone age up to 12 and 24 months;
vi. Participation in the B4 School health check (B4SC)[19] at age 4
vii. Attendance at an early childhood education (ECE) centre at age 4 (only observed for children who participated in the B4SC).[20]

There is a risk that since families may be referred to FS by an addiction or mental health service, contact with those services might pre-date FS enrolment. Therefore, some or all of any increase in utilisation of these services might be coincidentally

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[18]Additional outcome variables were created by MSD (description of these is available upon request). The final set of outcomes used in this analysis was determined based on detailed examination of the FS programme and careful consideration of the programme logic.

[19]The B4SC is a pre-school screening health check conducted by a nurse or GP. It is the last health check in the Well Child/Tamariki Ora package of universal health services offered to all New Zealand families for children from birth to 5 years. Participation is voluntary. At the time of writing, centrally-held data on participation in Well Child/Tamariki Ora health checks other than the B4SC was not available.

[20]Linked person-level administrative data on ECE participation has only recently become available and was not in place for the cohorts studied. However the voluntary B4SC does ask parents "Which preschool, if any, does your child attend?" Responses to this question are analysed to provide a measure of probable ECE participation. The B4SC and ECE measures are only analysed in the individual-level results as the coverage of the B4SC was less comprehensive in the early part of the phase-in that is exploited in the community-level analysis. In the individual-level study which focusses on children born 2009-2011, data were only available for the cohort born in 2009 (and aged 4 in 2013) at the time the study data were extracted.

related to FS, rather than being caused by FS. To try and correct for this, we generate two variants of maternal use of these services in the child's second year of life. One variant is whether the mother used the relevant service in the second year. The other is whether the mother used the relevant service in the second year having had no usage of that service in the first year post-birth. Because most children who enrol in FS do so before the end of their first year, the latter measure is less likely to capture the effect of enrolees being referred to FS by the service, and any increase is more readily interpreted as reflecting the causal impact of FS on service utilisation.

Outcomes: Maltreatment Marker Injuries and CYF Contact

FS seeks to improve the safety of children and reduce the likelihood of maltreatment. Selecting measures to properly capture whether maltreatment is reduced as a result of home visiting programmes is challenging because the presence of a worker in the home could result in higher rates of referrals to child welfare service without any real increase in risk or harm (Fergusson et al, 2012; Gilbert et al., 2012). Indeed, programme manuals for FS workers encouraged reporting to CYF where there were concerns about child abuse or neglect (FaCS, 2009). There is also uncertainty about the adequacy of administratively recorded substantiated findings of maltreatment as a measure of the real occurrence of child maltreatment (Hussey et al., 2005; Drake, 1996; Fluke, 2009).

We examine a range of measures of contact with CYF in the first two years of life of the enrolled child. We note that interpretation of a positive impact on these measures should not be taken to imply an increase in maltreatment. The specific measures are:

  i.   Notification to CYF in the first and second year of life;
  ii.   A CYF substantiated finding of neglect, emotional abuse or physical abuse with respect to the child in the first and second year of life; and
  iii. A placement of the child while in care[21] that commenced in the first and second year of life.

Reverse causality presents a further difficulty with interpretation of these measures. Since many families are referred to FS via CYF, these CYF outcomes might pre-date FS enrolment. Therefore, increased CYF contact might be coincidental rather than causally related to FS. To try to correct for this, we generate a second variant of each of the CYF contact measures in the second year. This variant examines outcomes where the event is recorded in the second year of life, and no CYF notification was recorded in the first year of life. This captures events newly initiated in the second year of life, which in the majority of cases follows FS enrolment. Any increase or decrease is therefore more likely to be causally related to FS.

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[21]In most cases, children in care have an out of home placement. However for some children in care the placement recorded is at home.

We also examine three injury hospitalisation measures (in all cases, short-stay Emergency Department-only admissions were excluded) related to the child. These are:

i.   hospitalisation for intracranial injury in the first year of life (considered a marker for intentional injury (Gilbert et al. 2011));

ii.   hospitalisation for long-bone fracture injury in the first year of life (a marker for intentional injury (Gilbert et al. 2011)) and in the second year of life; and

iii. hospitalisation for maltreatment-related injury[22] in the first and second years of life.

As with CYF contact, some ambiguity in interpretation of any positive impact on these measures exists. For example, increased rates of hospitalisation might result from parents being more aware of the need to seek treatment early as a result of FS.

Outcomes: Childhood Mortality

Child mortality is examined as a measure of whether one of the ultimate aims of the programme — improved child health — was achieved. We use three mortality indicators:

i.   post neonatal mortality in the first and second year;

ii.   post neonatal Sudden Unexpected Death of an Infant (SUDI);[23] and

iii. post neonatal death due to injury or poisoning ("injury mortality") in the first and second year.[24,25]

We exclude the neonatal period because most children are enrolled in FS after birth and the timing and type of work undertaken with families might be expected to have less impact on risk factors for neonatal death. For example, monitoring requirements show an emphasis on promoting breastfeeding, connecting infants to immunisation

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[22]Hospitalisations for maltreatment-related injury included the following sub-classes: (1) maltreatment syndrome reflecting physical abuse or neglect as the cause of injury; (2) assault reflecting assault by carers (physical abuse) or violence by others, which may be due to inadequate supervision (neglect); (3) undetermined cause where there was explicit uncertainty about the cause of injury, which is likely to reflect physical abuse or neglect; and (4) adverse social circumstance reflecting concern about parenting, home environment, or child welfare. This may reflect neglect or physical abuse as a factor in the child's injury (Gilbert et al., 2012).

[23]Where the ICD-10-AM main underlying cause of death was: SIDS (R95); SUDI: Unspecified (R96, R98, R99); SUDI: Suffocation/strangulation in bed (W75); SUDI: Inhalation of gastric contents/food (W78, W79).

[24]Where the ICD-10-AM main underlying cause of death was V01-Y36. This includes: Transport accidents (V01-V99); Other external causes of accidental injury (W00-X59); Intentional self-harm (X60-X84); Assault (X85-Y09); Event of undetermined intent (Y10-Y34); Legal intervention and operations of war (Y35-Y36). Note deaths due to suffocation/strangulation in bed and inhalation of gastric contents/food are included in both the SUDI outcome and the injury mortality outcome examined in this study.

[25]Mortality data were drawn from a national mortality collection (Ministry of Health, 2009). New Zealand has a well-developed system for mortality data collection and review (New Zealand Mortality Review Group, 2013). We expect little or no measurement error in these data, although deaths that were concealed will have been missed.

and primary health services and health checks, and connecting families to services that could help address family violence and other difficulties. Programme manuals also show a focus on reducing home hazards, keeping the home and car smoke-free and promoting responsive care of the child. As previously indicated, there was an emphasis on reporting to CYF where there were concerns about child abuse or neglect (FaCS, 2009). These activities would be expected to improve the health and physical safety of the child. Our primary outcome of interest is all-cause post neonatal mortality. In addition, based on the likely channels through which home visiting would impact mortality, we investigate preventable deaths, specifically those due to post neonatal SUDI and post neonatal injury mortality (Olds et al., 2014).

Examining impacts on these outcomes is of particular interest because infant mortality rates are high in New Zealand compared with other OECD countries (Simpson et al., 2014). Rates of SUDI are especially high, particularly for Māori infants (New Zealand Mortality Review Group, 2013).

4. Estimation Strategy

We utilise two distinct methods to estimate the impact of FS on the above mentioned outcomes: propensity score matching (PSM) at the individual level and fixed effects (FE) at the TLA (community) level. These two methods both focus on examining impacts in the 14 TLAs to which FS was "phased-in" as part of the 2005-2007 enhancement and expansion, and use the 44 never treated TLAs as a source of controls.

We exclude TLAs that had been served by FS from prior to 2001 from the study entirely. FS in these TLAs commenced under different contracting rules and service specifications to the enhanced programme that applied from mid-2004 (see Appendix A for more details). While all providers were ultimately brought under the same contract terms and service specifications, the pre-existing providers were transitioning to the new arrangements over the period of our study, making FS in these TLAs somewhat different in nature to that delivered in the 2005-2007 phase in TLAs.

We allocate a mother to a TLA based on her location at the birth of the child and as recorded in maternity records. We examine TLAs as they were defined in 2006.[26] From the 44 never treated TLAs[27] we drop Carterton, Clutha, Kapiti Coast, Southland, Tasman and Thames-Coromandel because we could not establish whether they were treated.[28] We also drop the Chatham Islands because there were too few births.

4.1 Propensity Score Matching (Individual Level)

FS-Net is a database where details of the children who enrolled in FS are recorded. Unfortunately, this system was only introduced in late 2008 and therefore does not span the whole period following the 2005 phase in. We are able to observe individual enrolment status for children born between quarter 1 of 2009 and quarter 4 of 2011 using FS-Net.[29] Enrolment is defined as being referred to a provider, being accepted

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[26]Our study period predates the amalgamation of Auckland TLAs that occurred with the formation of the Auckland Supercity.

[27]Overseas and undefined is not included in this count.

[28]These areas bordered treated TLAs and a relatively high proportion of the children were observed to receive FS based on 2009-2011 enrolment data. These children may have moved to an area where FS was available after birth, or may have been served by a provider who was contracted to provide services in some parts of the neighboring TLA, or offering service to families outside their contracted area.

[29]We were not able to link records in every case because identity details are sometimes not fully recorded –16% of engagements where a child is accepted onto FS cannot be linked to a birth record. This is the result of poor identity recording. Because we do not draw the control group for the propensity score matching from areas where FS was available, this unobserved programme participation, so long as it was randomly distributed, is unlikely to have biased results (had we drawn the control group from *within* areas where FS is available, however, we could not have been sure that controls were truly untreated). If failure to link records was non-random, this is a potential source of bias (eg. if individuals for whom the programme was most

onto the programme and the family agreeing to be in the programme. Linked data on referrals (as opposed to enrolments) are not available.

Our estimation strategy relies on comparing individuals enrolled in FS-net (in treated TLAs) to matched individuals in never-treated TLAs. Our sample consists of 57,999 births in phased-in TLAs and 59,838 births in never-treated TLAs born in 2009, 2010 or 2011.

Since we are drawing on controls from never treated TLAs, we need to establish whether there were any systematic differences between treated and never treated TLAs. To understand the process of how TLAs came to be treated, we reviewed policy advice prepared at the time of the expansion (MSD, 2004a; MSD, 2004b). These documents suggest that programme expansion occurred in TLAs that were assessed to be "high-need".

The method used to classify a TLA as high need relied on identifying the number of smaller areas within a TLA that were classified as having a "NZDep" ranking of 10.[30] The number of births that occurred within these high-need areas as a proportion of all births within the TLA in 2002 was then calculated. TLAs that had more than 15% of births in NZDep10 Census Area Units in 2002 were selected for further consideration. Amongst these high-need TLAs, priority was given to cities and towns with greater numbers of such families (MSD 2004b). Four additional rural TLAs with smaller numbers of vulnerable families were also selected for the expansion. Given that NZDep and rural-urban status were criteria used to select the expansion TLAs, these characteristics are used as criteria for matching between treated and control subjects.

We estimate the propensity matched treatment effect as follows. First, we estimate the following equation for the sample of 57,999 births (of which 3,360 were enrolled in FS) in the treated TLAs that were part of the expansion:

(1) $$\Pr(I_i = 1|Z_i) = \Phi(\beta_0 + \beta_1 Z_i)$$

where $I_i = 1$ if the birth was enrolled in FS, and 0 if not; Z_i is a vector of individual characteristics (described below) that predict treatment and $\Phi(.)$ is the cumulative standard normal distribution function.

The set of variables in Z_i is meant to reflect criteria used by referral agencies to determine whether a family was eligible and also to reflect the willingness of the family to participate. These include the characteristics of the mother, the father and

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effective were the least likely to be linked, impacts will be understated). From the data available for analysis, we had no means of exploring this possibility.

[30]NZDep (New Zealand Index of Socio-economic Deprivation) is based on nine variables taken from the Population Census (income, home ownership, single parent family or not, employment, adult qualifications, living space, communication and transport) and is updated after every Census. These nine variables are used to sort Census meshblocks (the smallest geographic unit for which statistical data is collected - approximately 50 households) into "deprivation deciles" with NZDep1 being the best-off and NZDep10 the worst-off (Salmond et al., 2007).

the child and siblings. Referral criteria are described in detail in Appendix A Box 5. The overall regression has a pseudo R-Squared statistic of 0.208. Given that the first stage is a probit estimate, which typically yields low pseudo R-squares, this is a reasonably good first stage regression.

Using the estimated betas from the first stage, we calculate a propensity score for the 59,514[31] births in the never-treated TLAs. Due to computational speed limits, prior to matching we drop all individuals with a propensity score lower than the median propensity score (0.007). This leaves us with a total of 29,796 individuals in never-treated TLAs who can act as potential controls for 3,291 treated individuals.

We then use one-to-one nearest neighbour matching (with replacement) in Stata 13 using the command "tseffects nnmatch" to estimate the average treatment effect. This is the most straightforward matching method. We use exact matching using variables selected according to the following criteria: (i) there being sufficient matches; (ii) being either criteria on which the treatment TLAs were chosen or criteria that control for important demographic factors (these are explained below); and (iii) improving the balance of the treated and matched control group.

We exact match on ethnicity of the child (Māori, Pacific (if not Māori), other ethnic groups), whether the neighbourhood at birth was in NZDep 9 or 10 (the most deprived quintile), whether the child was registered on a main benefit by 13 weeks of age combined with maternal age (mother under 20, mother 20 or over and on a benefit, mother 20 or over and not on a benefit[32]), urban location (urban, others)[33] and the birth-year. Note that because Pacific births (where the child is not also Māori) are highly concentrated in urban areas and are a relatively small sample of the treated, we relaxed the urban location criteria for these children, allowing them to be matched regardless of rural-urban status.

Within each of these sub groups, we match the treated birth with an untreated birth in a never treated TLA with the closest propensity score. When distances in terms of propensity are tied, we use more than one control. Note that reported standard errors are not adjusted for the fact that the propensity is an estimate, thus they may be larger than they should be which will lead us to underestimate the statistical significance of the effects (Abadie and Imbens 2009).

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[31]Some children in the never treated FS were found to be enrolled in FS, possibly because they had moved into a treated TLA after birth, or a provider was contracted to serve children in small parts of a neighboring otherwise untreated TLA or served families outside their contracted boundaries. We exclude these children from the analysis.
[32]The reason we do not match children with mothers aged under-20 by benefit status is because there are very few young mothers who are not supported by benefit
[33]The urban-rural status information available from the Maternity Collection data at the time of writing was known to disproportionately attribute urban status where an address could not be readily matched to an area unit code (eg. in the case of a rural delivery (RD) address). The accuracy of the matching is constrained by this data limitation.

Figure 3 shows the common support between the treated and matched controls. These histograms indicate that we have overlapping samples. To establish the balance between the treated and matched controls, the standard practice is to compare the characteristics of the treated and control samples. However, because we have also exactly matched the samples, this is somewhat more complicated because we would ideally want to look at the characteristics within each matched sub-sample. Table 1 compares the treated and control samples overall on selected characteristics (Panel A), and also shows means for all births in the phased-in and never-treated TLAs (Panel B).[34]

Figure 3: Histograms of treated and matched control samples

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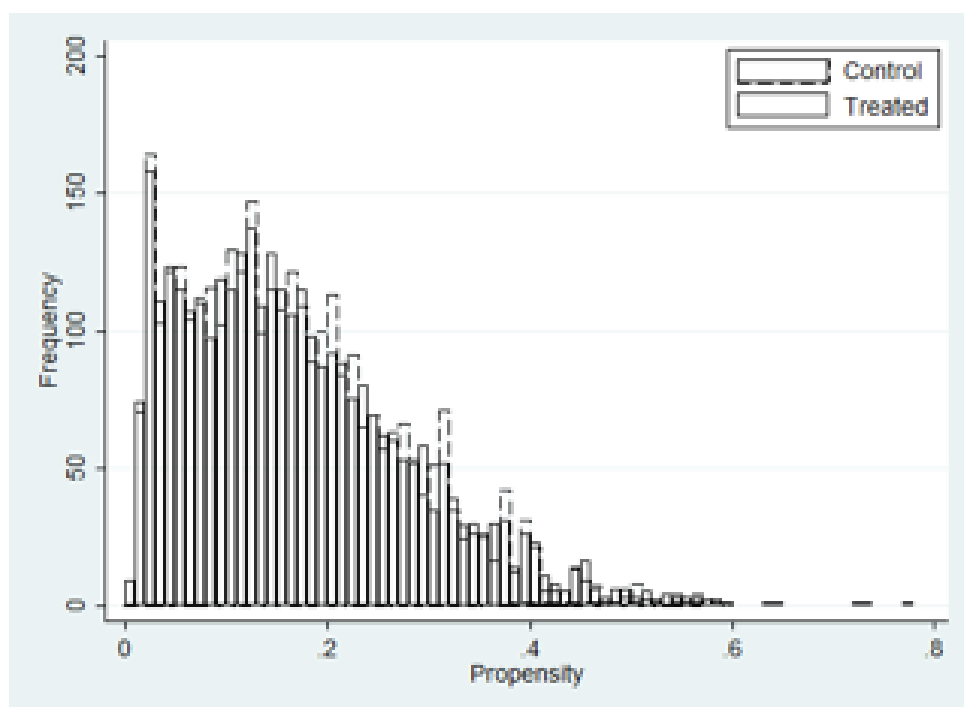
[34]The means are calculated for the matched control for each treated. For those treated that have multiple tied matches, a random match is chosen.

Table 1 Panel A: Mean Characteristics in PSM Treated and Control Samples [95% CI]

	Treated		Control	
Matching variables				
Propensity score	0.170	[0.166, 0.174]	0.167	[0.164, 0.171]
Māori child	0.533	[0.516, 0.550]	0.533	[0.516, 0.550]
Pacific child*	0.315	[0.299, 0.331]	0.315	[0.299, 0.331]
Mother under 20 at child's birth	0.234	[0.219, 0.248]	0.234	[0.219, 0.248]
Urban	0.577	[0.560, 0.594]	0.527	[0.510, 0.544]
NZDep9 or 10	0.747	[0.732, 0.762]	0.747	[0.732, 0.762]
Child supported by welfare benefit within 13 weeks of birth	0.726	[0.710, 0.741]	0.718	[0.702, 0.733]
Other characteristics (selected for their relevance to the targeting of FS)				
Mother single at birth of child	0.681	[0.665, 0.697]	0.659	[0.643, 0.675]
Mother supported by benefit for more than 3 of last 5 years	0.461	[0.443, 0.478]	0.402	[0.385, 0.418]
Mother served a sentence in the 5 years prior to child's birth	0.146	[0.134, 0.158]	0.152	[0.140, 0.164]
Maternal history of addiction service usage in 5 years prior to child's birth	0.076	[0.067, 0.085]	0.069	[0.060, 0.078]
Maternal history of non-addiction mental health service usage in 5 years prior to child's birth	0.177	[0.164, 0.190]	0.161	[0.148, 0.174]
Mother had record of substance abuse or other mental health issues in 5 years prior to birth	0.226	[0.212, 0.241]	0.224	[0.210, 0.238]
Mother notified to CYF before age 18	0.369	[0.352, 0.385]	0.354	[0.338, 0.371]
Mother smoked at time of delivery	0.380	[0.363, 0.396]	0.383	[0.366, 0.399]
Father recorded on birth registration	0.824	[0.810, 0.837]	0.832	[0.820, 0.845]
Father served a sentence in the last 5 years	0.326	[0.310, 0.342]	0.319	[0.303, 0.335]
Father received incapacity benefit for mental health or substance abuse in the 5 years prior to child's birth	0.081	[0.071, 0.090]	0.111	[0.099, 0.121]
Father notified to CYF before age 18	0.225	[0.211, 0.239]	0.233	[0.219, 0.247]
Other children with CYF Police family violence notifications or contact records in the last year	0.117	[0.106, 0.128]	0.081	[0.071, 0.090]
Other children with CYF notifications or CYF Police family violence contact records in the last 5 years	0.292	[0.277, 0.308]	0.245	[0.230, 0.260]

Note: The "Treated" and "Control" columns are both under the spanning header "PSM sample".

* Pacific child is defined as Pacific and not Māori for the PSM sample to reflect the Māori prioritised ethnicty definition used for matching.

Table 1 Panel B: Mean Characteristics in Phase-in and Never Treated TLAs Overall [95% CI]

	All births 2009-2011			
	Phase-in TLAs		Never Teated TLAs	
Matching variables				
Māori child	0.274	[0.272, 0.276]	0.246	[0.244, 0.248]
Pacific child*	0.294	[0.291, 0.296]	0.066	[0.064, 0.067]
Mother under 20 at child's birth	0.074	[0.073, 0.075]	0.060	[0.059, 0.061]
Urban	0.694	[0.691, 0.696]	0.464	[0.461, 0.466]
NZDep9 or 10	0.451	[0.448, 0.453]	0.099	[0.098, 0.101]
Child supported by welfare benefit within 13 weeks of birth	0.264	[0.262, 0.266]	0.172	[0.171, 0.174]
Other characteristics (selected for their relevance to the targetting of FS)				
Mother single at birth of child	0.275	[0.273, 0.277]	0.173	[0.171, 0.175]
Mother supported by benefit for more than 3 of last 5 years	0.189	[0.187, 0.191]	0.118	[0.116, 0.120]
Mother served a sentence in the 5 years prior to child's birth	0.037	[0.036, 0.037]	0.031	[0.030, 0.031]
Maternal history of addiction service usage in 5 years prior to child's birth	0.017	[0.016, 0.017]	0.015	[0.014, 0.016]
Maternal history of non-addiction mental health service usage in 5 years prior to child's birth	0.054	[0.052, 0.055]	0.063	[0.061, 0.064]
Mother had record of substance abuse or other mental health issues in 5 years prior to birth	0.070	[0.068, 0.071]	0.078	[0.077, 0.080]
Mother notified to CYF before age 18	0.091	[0.090, 0.093]	0.078	[0.077, 0.079]
Mother smoked at time of delivery	0.143	[0.141, 0.145]	0.122	[0.121, 0.124]
Father recorded on birth registration	0.922	[0.920, 0.923]	0.957	[0.956, 0.958]
Father served a sentence in the last 5 years	0.109	[0.107, 0.111]	0.089	[0.087, 0.090]
Father received incapacity benefit for mental health or substance abuse in the 5 years prior to child's birth	0.028	[0.028, 0.029]	0.033	[0.032, 0.034]
Father notified to CYF before age 18	0.065	[0.063, 0.066]	0.060	[0.059, 0.062]
Other children with CYF Police family violence notifications or contact records in the last year	0.021	[0.021, 0.022]	0.011	[0.010, 0.011]
Other children with CYF notifications or CYF Police family violence contact records in the last 5 years	0.079	[0.077, 0.080]	0.051	[0.050, 0.052]

* Pacific child is defined as Pacific and not Māori for the PSM sample to reflect the Māori prioritised ethniticty definition used for matching.

While a few characteristics are unbalanced from a statistical sense, these differences are for the most part not economically meaningful. If anything, they suggest the treatment group faced a greater number of challenges than the control sample. For example, the treatment group comprises a higher proportion with a single mother (68% vs. 66%, significantly different at p<.05) and have a history of more persistent benefit dependency (46% of the treated having been supported by a main benefit for at least 3 of the 5 years prior to the birth of the child compared with 40% of the matched controls, significantly different at p<.01). The treatment group is also more likely to have other children who had come to the attention of CYF as a result of a notification or Police family violence referral or contact record. The one exception to this pattern is that fathers in the control group are more likely to have received benefits with an incapacity code that indicates substance abuse or other mental health difficulties.

4.2 Fixed Effects (Community Level)

The second approach we use is to exploit the phase-in of the FS programme over the period of study. We focus on the phased-in TLAs as well as the never treated TLAs. We aggregate the data at the TLA level, dropping quarters when there are no recorded births in the TLA. There are a total of 51 TLAs and 1,444 TLA-Quarter birth cohorts in the study sample. Table 2 provides more detail of the phase-in and the number of births in the never treated and phase-in TLAs in each quarter.

We estimate the following equation:

(2) $$\overline{Y}_{kt} = \alpha_k + \delta_t + \gamma FS_{kt} + \tau TEEN_{kt} + u_{kt}$$

Where $\overline{Y}_{kt}$ is the mean outcome of interest in TLA k in quarter t, and α_k and δ_t are the dummy TLA and time (quarter) effects, respectively.[35] The variable FS_{kt} takes on a value of 1 if FS is available in the TLA in the quarter; 0 otherwise. The variable $TEEN_{kt}$ is the mean births in TLA k and quarter t to mothers aged under 18.

The coefficient γ represents the average impact of FS introduction as long as the timing of the phase-in for this programme is "random" with respect to the outcome of interest. If, however, the sequencing of the phase in is correlated with expected rates of change in the outcomes, then our estimates will be biased.

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[35]Due to the fact that there was a decline in teen birth rates over this time, the FE regression includes a control for the TLA/quarter share of mothers with maternal age under 18. While the results are robust to dropping this, we included the control in order to assure the reader that the downturn in teen births over the latter part of the study period was not driving our results. We also estimated this model with a more extensive set of time varying controls and results are qualitatively the same. As changes in these controls were not correlated with changes in the outcome of interest in the control group, we choose not to include them in our preferred specification. Results including more extensive controls are available from the authors upon request.

Table 2: Number of Births by Treatment Status of TLA

| | Number of TLAs | Number of births quarter 3, 2004-Quarter 4, 2011 | |
		Total	Child included benefit within 13 weeks of birth
Never treated	37	145,581	25,110
Phased in 2005-07	14	142,323	37,611
Phase-in TLAs by quarter service commenced:			
2005Q3	2	50,037	9,066
2006Q1	2	61,032	18,450
2006Q3	4	22,074	7,227
2006Q4	4	4,788	1,371
2007Q3	2	4,389	1,497

Note: TLAs in the never treated group for the analysis exclude Carterton, Clutha, Kapiti Coast, Southland, Tasman and Thames-Coromandel because we could not establish whether they were treated. We also excluded the Chatham Islands because there are few births, and "Overseas and undefined". TLAs where FS has operated since before 2001 were not used in any of the analysis.

We restrict the analysis to those children who were included in a main welfare benefit within 13 weeks of birth. These children were eligible for FS due to the fact that families could qualify on the basis of low income alone during the period studied (although in practice most qualified on multiple criteria (MSD, 2009)).[36]

As mentioned above, the value of the quasi-experimental design generated by the staggered phase-in of FS for measurement purposes depends on its timing. If, for example, the sequencing of the phase in is correlated with expected rates of change in the outcomes, then a bias will be introduced and any impacts we estimate could be a consequence of the differential trends, not a true impact of FS. This is sometimes referred to as the "common trends" assumption. To test whether phase in is responding to trends in the outcome variable we follow the approach taken by Autor (2003) and estimate the following model:

(3) $\quad \overline{Y}_{kt} = \alpha_k + \delta_t + \gamma_{-4} FS_{kt-4} + \gamma_{-3} FS_{kt-3} + \gamma_{-2} FS_{kt-2} + \gamma_{-1} FS_{kt-1} + \gamma_0 FS_{kt} +$

$$\gamma_{+1} FS_{kt+1} + \gamma_{+2} FS_{kt+2} + \gamma_{+3} FS_{kt+3} + \gamma_{+4} FS_{kt+4} + u_{kt}$$

For example, the estimated coefficient for γ_{-2} captures the 2-quarter lead or "anticipatory" effect of FS. To test whether roll-out is as good as random we calculate a

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[36] In the 2009-2011 cohorts, just over 70% of children enrolled in FS were included in a main welfare benefit within 13 weeks of birth.

joint F-test on the lead coefficients ($H_0: \gamma_{-4} = \gamma_{-3} = \gamma_{-2} = \gamma_{-1} = 0$). If we can't reject this null hypothesis then we can interpret our results as causal.

4.3 Sub-group Analysis

For both estimation strategies we also look at Māori and Pacific sub-groups based on the ethnicities of the children.[37] For the FE community analysis we undertake sub-group analysis for births within the benefit sub-population where the child is (i) Māori and (ii) Pacific. The aim of this sub-group analysis is to see whether impacts were seen across the major ethnic groups targeted by the programme. Moreover, these results are of particular interest because evidence on the effectiveness of such programmes for ethnic minorities and indigenous communities are rare. Table 3 provides a conservative estimate of programme coverage for each group, which will be important in comparing the results between the community-level FE and individual-level PSM estimates. Coverage rates range from 15-18 percent, although this is likely an under-report for two reasons: (i) 16% of FS engagement records were unable to be linked to a child record in the linkage due to incomplete recording of identity details; and (ii) children who are the younger siblings of an already enrolled child (ie. born to programme participants while they are participating in the programme) are generally not recorded as receiving FS. Note also that children who are the younger siblings of a previously enrolled child (ie. born to programme participant mothers after they participated in the programme) may benefit from FS but are not recorded as receiving it.

Table 3: Estimated Programme Coverage in Phase-in TLAs by FE Sub-group

	Births where child included benefit within 13 weeks of birth			Total births in phase-in TLAs
	All	Māori child	Pacific child	
Proportion of births 2009-2011 in phase in TLAs recorded in FS-Net	0.151	0.181	0.149	0.058

4.4 Comparing Propensity Score Matching to Fixed Effects

While it is possible both approaches will give the same results, they are estimated using different samples and over different time periods so there are a number of reasons why the results might differ between the estimation approaches. First, the PSM technique uses data for cohorts born from quarter 1 of 2009 to quarter 4 of 2011, while the FE approach uses data for cohorts born from quarter 3 of 2004. If there were lags in

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[37]The sub-group analysis is conducted using "total response" measures of ethnic affiliation. As a result, a child can appear in both the Māori and Pacific sub-groups.

effectiveness following implementation (Matone et al., 2013), the PSM study may relate to a period during which programme impacts were greater, on average.

Second, the PSM approach compares individuals who enrolled in FS in treated communities to individuals with similar propensity to enrol in never-treated communities. The FE approach compares average outcomes before and after the introduction of the programme across the whole beneficiary sub-population. Therefore, the FE approach does not allow us to isolate the impact on only those enrolled.

An advantage of the FE method is that it does allow us to consider potential spill-over effects between the enrolled and other people living in the same community as well as to subsequent births to mothers who received FS for their earlier children.

Overall, the PSM results should be thought of as estimating the average treatment effect of the programme on those who take-up the programme, while the FE approach should be interpreted as the impact of offering the programme at the community level.

4.5 Interpreting Effect Sizes

It is worth briefly discussing how to interpret the results. The PSM results can all be interpreted as the average change in the probability of the outcome occurring as a result of treatment. To calculate the effect per 1,000 individuals, the estimated coefficient would need to be multiplied by 1,000. For example, the effects size quoted for SUDI deaths in the PSM is -0.0011. This is a point estimate of treatment effects of a reduction in deaths of 1.1 per 1,000 live treated births. Some of the outcomes measured in this study are rare – SUDI deaths being a case in point. In this case, the point-estimate of effect size should be treated with caution in interpreting programme effects. Instead, the 95% confidence interval ought to be used when discussing possible programme impacts.

For the FE results, all outcomes are constructed as community-level averages. Thus, the estimated effect sizes are simply the average treatment effect on the proportion of the studied population in the TLA with the outcome. For example, the effect size on post neonatal infant mortality for the benefit population is estimated at -0.0035. The interpretation is that for the average treated TLA, the introduction of FS reduced post neonatal infant mortality by 3.5 per 1,000 live births for the population of children supported by benefit within 13 weeks of birth.

To assist with comparison to other published studies we also show Cohen's d across all outcomes for the PSM. We calculate this using the t-statistic (from the PSM estimate) and sample sizes in each treatment arm (3,291 individuals in each of the treated and matched control group). The formula for Cohen's d is calculated as follows:

$$d = t \sqrt{\left(\frac{n_t + n_c}{n_t n_c}\right)\left(\frac{n_t + n_c}{n_t + n_c - 2}\right)}$$

where n_t and n_c are the sample sizes of the treatment and matched control groups, respectively.

5. Results

5.1 Descriptive Statistics

Table 1 presents the selected covariates for the PSM treated and matched control sample. Consistent with findings from the Growing Up in New Zealand Study (Morton et al., 2015), families that access Family Start have a highly disadvantaged profile,[38] and the characteristics of the matched controls reflect the fact that FS is targeted to high-need families: 75% of the children are resident in an area in the most deprived NZDep quintile; 66% have a single mother; 40% of the mothers have been supported by a main welfare benefit for greater than 3 of the 5 years prior to the birth of the child; 53% of the children are Māori; and 47% of the children are Pacific (this proportion falls to 32% when counting only children who were Pacific and not Māori).

Table 4 provides descriptive statistics for the outcomes of interest. Panel A shows means and standard deviations of outcomes in the PSM control group, and Panel B shows the mean in the non-treated sample of the community-level FE regression both overall, and corresponding to the phase in (pre phase in, during phase in and post phase in). Due to the rarity of some events, and the confidentiality rules imposed by Statistics New Zealand, we round rates up to 3 decimal places.

It is useful to compare our baseline rates of mortality with published results. The rate of post neonatal infant mortality in the matched control sample used for the PSM analysis is 1 per 1,000 while the rate in the untreated sample in the community-level FE estimates is 3 per 1,000. The difference in rates could be due to the difference in time periods, with the PSM data spanning a later period when infant mortality had declined, or because the community-level rate is only for the beneficiary population. Ministry of Health Data shows that between 2005 and 2011 post neonatal mortality in the most deprived quintiles averaged 4 per 1,000.[39]

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[38]In the Growing Up in New Zealand sample, the majority of families who had accessed FS by the time their child was 2 years had been in the "high vulnerability" risk group during late pregnancy (Morton et al., 2015).

[39]Fetal and Infant Deaths 2011, (see http://www.health.govt.nz/publication/fetal-and-infant-deaths-2011). Downloaded 30 September, 2015.

	Outcomes in the First Year of Life		Outcomes in the Second Year of Life		Outcomes in the Second Year of Life (With no Service Contact* in the First Year or Life)		Outcomes in the Fifth Year of Life	
Mother Received Addiction Service	0.024	[0.018, 0.029]	0.033	[0.027, 0.039]	0.015	[0.010, 0.019]	N/A	N/A
Mother Received Mental Health Service	0.053	[0.048, 0.061]	0.043	[0.036, 0.050]	0.020	[0.015, 0.024]	N/A	N/A
Enrolled with PHO	0.967	[0.961, 0.973]	0.973	[0.967, 0.978]			N/A	N/A
Fully Immunized at Every Milestone Age	0.571	[0.554, 0.588]	0.515	[0.498, 0.532]			N/A	N/A
Fully Immunized at 1+ Milestone Age	0.840	[0.827, 0.852]	0.918	[0.909, 0.927]			N/A	N/A
Participated in B4SC (2009 Cohort Only)	N/A		N/A				0.633	[0.604, 0.662]
Attended ECE (for those who participated in B4SC, only for 2009 cohort)	N/A		N/A				0.770	[0.737, 0.801]
Hospitalized for Long Bone Fracture	0.003	[0.001, 0.005]	0.002	[0.000, 0.003]			N/A	N/A
Hospitalized for Intracranial Injury	0.002	[0.001, 0.004]	N/A				N/A	N/A
Hospitalized for Maltreatment Injury	0.003	[0.001, 0.005]	0.001	[0.000, 0.002]			N/A	N/A
Any Notification	0.207	[0.194, 0.221]	0.198	[0.181, 0.214]	0.079	[0.068, 0.090]	N/A	N/A
Findings of Emotional Abuse	0.049	[0.042, 0.057]	0.050	[0.041, 0.059]	0.015	[0.010, 0.020]	N/A	N/A
Findings of Physical Abuse	0.004	[0.002, 0.006]	0.002	[0.000, 0.004]	0.000	[-0.00, 0.001]	N/A	N/A
Findings of Neglect	0.020	[0.015, 0.024]	0.022	[0.016, 0.028]	0.005	[0.002, 0.008]	N/A	N/A
Placement Commenced	0.014	[0.010, 0.018]	0.008	[0.004, 0.012]	0.001	[-0.00, 0.002]	N/A	N/A
Post Neonatal Mortality	0.001	[-0.000, 0.002]	0.000	[0.000, 0.000]			N/A	N/A
Post Neonatal SUDI	0.001	[-0.000, 0.001]	N/A				N/A	N/A
Post Neonatal Injury Death	0.001	[-0.000, 0.001]	0.000	[0.000, 0.000]			N/A	N/A

* For measures of CYF contact, this is defined as having had no notification in the first year of life.

Hospitalisation for long bone fractures and intracranial injuries is rare (3 and 2 per 1,000 respectively in the first year in the PSM control sample) as is hospitalisation for maltreatment-related injuries (3 per 1,000 in the first year and 1 per 1,000 in the second year). In contrast, notification to CYF is common with 20% of the matched control sample being notified in their first year and 13% having additional (or new) notifications in their second year. Placement is also surprisingly common with 14 per 1,000 of the matched control sample having commenced a placement with the first year of life. This rate falls to 8 per 1,000 in the second year. Given the high needs of these families it is surprising to find that 97% of the children are enrolled in a PHO by age 1 suggesting that primary care engagement is very high.

Table 4 Panel B: Means of Outcomes in the Control Group Over Time, Benefit Population (Community, FE, First Year Outcomes Only)

	Mean			
	Overall	Q3 2004-Q2 2005	Q3 2005-Q2 2007	Q3 2007-Q4 2011
Mother Received Addiction Service	0.019	0.012	0.015	0.023
Mother Received Mental Health Service	0.070	0.050	0.060	0.079
Enrolled with PHO	0.961	0.944	0.955	0.967
Hospitalized for Long Bone Fracture	0.0017	0.0004	0.0032	0.0014
Hospitalized for Intracranial Injury	0.0010	0.0010	0.0014	0.0009
Hospitalized for Maltreatment Injury	0.0006	0.0017	0.0004	0.0004
Any Notification	0.199	0.126	0.174	0.226
Findings of Emotional Abuse	0.033	0.016	0.026	0.039
Findings of Physical Abuse	0.005	0.004	0.005	0.005
Findings of Neglect	0.026	0.021	0.029	0.026
Placement Commenced	0.014	0.010	0.021	0.011
Post Neonatal Infant Mortality	0.0034	0.0015	0.0039	0.0037
Post Neonatal SUDI	0.0017	0.0007	0.0023	0.0016
Post Neonatal Infant Injury Death	0.0010	0.0002	0.0008	0.0012

5.2 Early Childhood Education and Health Service Engagement

Note that the confidence intervals of estimated effects reported in the present paper all relate to the 95% confidence interval (CI).

Table 5A shows the estimated effect of FS on service utilisation using the PSM strategy. It suggests that mothers of children who participated in FS were 14.6 percentage points (CI, 8.1 to 21.1 percentage points) more likely to use non-addiction mental health services in the first year of the child's life and 8.0 percentage points (CI, 3.1 to 12.9 percentage points) in the second year.

Similarly, they were also found to be 2.6 percentage points (CI, 0.9 to 4.3 percentage points) more likely to take up addiction services in the first and year and 2.5 percentage points more likely in the second years (CI, 0.4 to 4.7 percentage points).

However, when we look at the second year use of services where there was no first year use, we find that the second year effect is no longer significant. We are therefore

concerned that the first year effects estimated for mental health and addiction services might be solely due to the fact that families who come into early contact with mental health or addiction services are more likely to be referred to FS. To further explore this possibility, we estimated an alternative specification which restricted the analysis to only those FS enrolees who were enrolled in FS pre-birth.[40] The outcome was first year service utilisation where there had been no service usage in the year prior to the birth. This ensures that the FS enrolment always pre-dates the initiation of addiction and mental health services. With this alternative specification, we find a statistically significant (at the 95% level) increase in mental health service usage in the first year, but no significant increase in addiction service usage (although the estimated sign is positive).

Our results therefore suggest that there is likely to have been some increase in mental health service usage due to FS but that the estimated increase in addiction service usage might have been due to reverse causality.

Surprisingly, enrolment with a PHO at the child's first birthday is estimated to be lower amongst the children enrolled in FS (estimate, -3.1 percentage points; CI, -4.8 to -1.3 percentage points). At the second birthday there is no statistically significant estimated effect of PHO enrolment. One potential explanation for this is that families relied on FS workers and other services such as immunisation outreach and Well Child/Tamariki Ora for medical advice in the first year and were less likely to register with primary care services. Given the importance of primary health care in infancy, this is a concerning result and warrants further qualitative investigation.

The results for immunisation suggest an increased rate amongst FS families. Children enrolled in FS are 5.0 percentage points (CI, 2.7 to 7.2 percentage points) more likely to be fully immunised at one or more milestone by age 1, and 3.8 percentage points (CI, 1.8 to 5.7 percentage points) more likely to be fully immunised at one or more milestone by age 2. There is also an increase in the likelihood of full immunisation at every milestone by ages 1 and 2.

The impact of FS on immunisation may have been smaller in the PSM study period compared to earlier periods. This is because 2009 onwards coincided with national health campaigns and service innovations which had a focus on improving uptake and service delivery for high-needs families nation-wide.[41]

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[40]Due to the smaller sample size, we were unable to find exact matches by year of birth, so birth year (as a dummy categorical variables) was used as an additional control rather than as a matching variable.

[41]Increased immunisation became a health target in August 2007, and in July 2009 it was made one of six "National Health Targets". Activities to achieve the targets included outreach immunisation services delivered through contracts with a range of services such as PHOs, Primary care, Well Child/Tamariki Ora, Māori and Pacific providers. As a result of these activities, immunisation rates were increasing rapidly over the period of this study (Ministry of Health, 2011).

Table 5A: Impact of Family Start on Early Childhood Education and Health Service Engagement (Individual PSM)

	Coefficient estimate (with 95% CI and p-value) on Family Start indicator		
	Outcomes in the First Year	Outcomes in the Second	Outcomes in the Fifth Year
Mother Received Addiction Service	0.0258*** [0.009, 0.043] p=0.003	0.0253** [0.004, 0.047] p=0.023	N/A
(With No Addiction Service in First Year)	N/A	0.007 [-0.009, 0.023] p=0.394	N/A
Mother Received Mental Health Service	0.1459*** [0.081, 0.211] p=0.000	0.0800*** [0.031, 0.129] p=0.001	N/A
(With No Mental Health Service in First Year)	N/A	0.005 [-0.003, 0.013] p=0.234	N/A
Enrolled with Primary Health Organization	-0.0306*** [-0.048, - p=0.001	0.0020 [-0.009, 0.013] p=0.726	N/A
Fully Immunized at 1+ Milestone Age	0.0499*** [0.027, 0.072] p=0.000	0.0375*** [0.018, 0.057] p=0.000	N/A
Fully Immunized at Every Milestone Age	0.0486* [-0.009, 0.106] p=0.096	0.0543* [-0.002, 0.111] p=0.062	N/A
Participated in B4SC (2009 Cohort Only)	N/A	N/A	-0.1364 [-0.395, 0.123] p=0.302
Attended ECE (for those who participated in B4SC, only for 2009 cohort)	N/A	N/A	0.0755*** [0.033, 0.118] p=0.001

Notes: These estimates are from regressions using propensity score matching utilizing nearest neighbour matching on propensity score, with exact match on ethnic group, rurality, age of mother, child supported by benefit before 13 weeks, whether NZDep 9/10 and year of birth (for B4SC estimates, matching is on propensity score, with exact match on ethnic group, rurality, age of mother and whether NZDep 9/10). It compares treated individuals in phased-in TLAs with matched individuals in never-treated TLAs. Results can all be interpreted as the average change in the probability of the outcome occurring as a result of treatment (eg. a 4.99 percentage point increase in the proportion of children fully immunised at 1+ milestone by age 1, 95% CI 2.7 to 7.2 percentage points). Parameter estimates statistically different than 0 at 99% (***), 95% (**), and 90% (*) confidence.

The estimated effect of FS on participation in the B4SC[42] is not significantly different from zero. However, amongst children who did participate in the B4SC, FS children are estimated to be 7.6 percentage points (CI, 3.3 to 11.8 percentage points) more likely to attend an early childhood education centre. This strong and positive impact of FS on ECE participation could be partly due to the availability of an Early Learning Payment – which was a subsidy provided to families enrolled with FS that could be used to defray the cost of ECE for children between 18 months and 3 years. This scheme was only made available in some of the phase-in TLAs (Auckland, Manukau, Opotiki, and Lower Hutt – see Appendix A). Given the evidence for the effectiveness of quality early childhood education in improving outcomes of children growing up in disadvantaged settings (Yoshikawa et al., 2015) this is potentially an important impact of FS.

The FE method is not able to estimate the immunisation or B4SC outcomes because these outcomes only began to be comprehensively recorded after the beginning of the period of the FE study. Estimated effects on measures of health service engagement able to be examined are all insignificant (Table 5B).

Table 5B: Impact of Family Start on Early Childhood Education and Health Service Engagement for Benefit Population (Community FE, First Year Outcomes Only)

	Coefficient estimate (with 95% CI and p-value) on Family Start indicator
Mother Received Addiction Service	-0.0059
	[-0.017, 0.005]
	p=0.285
Mother Received Mental Health Service	-0.0070
	[-0.027, 0.014]
	p=0.510
Enrolled with Primary Health Organization	-0.0042
	[-0.024, 0.015]
	p=0.685

Notes: These estimates are from fixed effects regressions with robust standard errors clustered at the TLA level. Regressions control for quarter indicators as well as an indicator for whether the mother was under 18. Outcomes are divided by the total count in the community and thus can be interpreted as changes in the proportion in a community experiencing that outcome (eg. a 0.4 percentage point reduction in the proportion of benefit children enrolled with a PHO at age 1, 95% CI -2.4 to 1.5 percentage points and not statistically significant). Parameter estimates statistically different than 0 at 99% (***), 95% (**), and 90% (*) confidence.

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[42]Funding for additional early Well Child/Tamariki Ora contacts for first-time mothers and high-needs families with babies was secured in the 2011 Budget and implemented 2011/12. While delivery of these additional contacts has been variable across providers other than Plunket (Personal correspondence, MoH), the focus on improving service for high-needs families nationwide may explain the lack of any improvement in participation in the age 4 B4SC - the last Well Child/Tamariki Ora check - found for FS children in the 2009 birth cohort.

5.3 Maltreatment Marker Injuries and CYF Contact

Table 6A shows the estimated impact of FS on CYF contact and hospitalisation indicators from the PSM. All estimates for the hospitalisation measures are insignificant.

We have noted the need to be cautious in interpreting some of the results from the PSM analysis as truly causal. CYF contact could have pre-dated enrolment and therefore elevated rates of contact may suffer from reverse causality (they may reflect the fact that CYF can refer families to FS as a result of the family being notified). In addition, while the matched control sample for the study is similar to the group of children who received FS on most characteristics, they were more likely to be in a family where other children had previously come to the attention of CYF and this, rather than participation in FS, might explain some of the estimated difference in CYF contact.

The outcomes that are most robust to the reverse causality effect are the measures of CYF contact in the second year of life where there was no notification in the first. Since most children are enrolled by the end of the first year of life, these measures are likely to be indicative of outcomes where enrolment preceded the CYF contact. Estimated impacts on these outcomes are much smaller in size than estimated impacts on other measures of CYF contact, and only increased notification remains statistically significant. The estimated coefficients on findings and placement (while still positive in sign) are no longer statistically significant. Admittedly, this specification of the outcome is likely to under-estimate the casual effect (because findings and placements commenced early in the second year that relate to a notification late in the first are excluded, and possible impacts on eg. repeat notifications in the second year are not captured).

To further test the extent to which reverse causality could be contributing to the apparent increase in CYF contact in the first year of life, we estimated an alternative specification of the model, confining the analysis to FS children who enrolled prior to birth and only examining CYF outcomes where there was no pre-birth CYF contact. FS enrolment amongst this sub-sample pre-dated the CYF contact in all cases. Small[43] but significant estimated positive impacts on notification and emotional and physical abuse findings were found. The estimated programme impacts on neglect findings and placement were no longer significant.

These results are consistent with findings from studies of other home visiting programmes that have suggested increased agency contact may occur as a result of a worker visiting the home. For example, two studies have found reduced negative parenting behaviours and attitudes but no decrease in child welfare reports (Tufts Interdisciplinary Evaluation Research, 2015; Fergusson et al., 2005).

An alternative explanation for the positive impacts found is the possibility that FS had a real impact on maltreatment. This could occur, for example, if mothers were encouraged to enter training or work and this had unintended impacts on the quality of the supervision and care of children (Matone et al., 2013). However FS does not have a strong focus on promoting training and engagement in employment for mothers of very young children. We consider the likelihood that FS increased maltreatment to be very low given the programme content and guidance. Moreover, the evidence of reduction in injury deaths is not in keeping with this hypothesis.

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[43]The effect size from this alternative specification was less than a half of the effect from the baseline specification.

Table 6A: Impact of Family Start on Maltreatment Marker Injuries and CYF Contact (Individual PSM)

	Coefficient estimate (with 95% CI and p-value) on Family Start indicator		
	Outcomes in the First Year	Outcomes in the Second Year	Outcomes in the Second Year (With No Notification in First Year)
Hospitalized for Long Bone Fracture	0.0025 [-0.001, 0.006] p=0.178	-0.0004 [-0.010, 0.009] p=0.931	N/A
Hospitalized for Intracranial Injury	0.0005 [-0.002, 0.003] p=0.658	N/A	N/A
Hospitalized for Maltreatment Related Injury	0.0002 [-0.003, 0.003] p=0.881	0.0011 [-0.001, 0.003] p=0.294	N/A
Any Notification	0.1751*** [0.125, 0.225] p=0.000	0.1090*** [0.077, 0.141] p=0.000	0.0328** [0.007, 0.059] p=0.013
Findings of Emotional Abuse	0.0498*** [0.031, 0.068] p=0.000	0.0333*** [0.021, 0.045] p=0.000	0.0049 [-0.001, 0.011] p=0.123
Findings of Physical Abuse	0.0019** [-0.000, 0.004] p=0.050	0.0021 [-0.001, 0.005] p=0.170	0.0009 [-0.000, 0.002] p=0.187
Findings of Neglect	0.0211*** [0.010, 0.033] p=0.000	0.0087** [0.000, 0.017] p=0.042	0.0019 [-0.003, 0.006] p=0.402
Placement Commenced	0.0063* [-0.001, 0.014] p=0.091	0.0051* [-0.000, 0.010] p=0.066	0.0006 [-0.002, 0.003] p=0.603

Notes: These estimates are from regressions using propensity score matching utilizing nearest neighbour matching on propensity score, with exact match on ethnic group, rurality, age of mother, child supported by benefit before 13 weeks, whether NZDep 9 /10 and year of birth. It compares treated individuals in phased-in TLAS with matched individuals in never-treated TLAs. Results can all be interpreted as the average change in the probability of the outcome occurring as a result of treatment (eg. a 3.28 percentage point increase in the proportion of children with a notification in their second year having had no notification in their first year, 95% CI 0.7 to 5.9 percentage points). Parameter estimates statistically different than 0 at 99% (***), 95% (**), and 90% (*) confidence.

Results from the community level FE analysis (Table 6B) largely line up in terms of sign with the PSM estimates, but only CYF substantiated findings of emotional abuse show a significant positive impact. An exception is the physical abuse outcome, where the introduction of FS is estimated to have reduced physical abuse findings. The decline in physical abuse findings is estimated with low significance and also narrowly fails the common-trend assumption (see below). Therefore, this result should be treated with some caution. One hypothesis is that it reflects spill-overs. If increased early contact with CYF is preventive in that concerning behaviours are identified and addressed early (Tufts Interdisciplinary Evaluation Research, 2015), positive programme effects may accrue to subsequent children or extended family members.

An important area for further research is building a better understanding of the mechanisms by which contact with CYF was increased for programme participants and whether risks apparent early in the FS engagement could be used to better target and tailor interventions that could prevent child abuse and neglect (Duffy et al., 2015). Future investigation of the data with a longer follow-up should examine the trajectory of CYF contact as the children age. Many of those in the control group might eventually come into contact with CYF. If the initial increase in notifications as a result of the programme is preventive, positive programme effects may accrue in the longer term. While the estimated effects on placement are not highly significant (and in the second year variant intended to control for reverse causality is not significant), the sign is positive. If as a result of increased contact, additional children who were "on the margin of placement" (Doyle, 2008) were placed, then the potential costs and possible preventive benefits of such actions should be further explored.

Table 6B: Impact of Family Start on Maltreatment Marker Injuries and CYF Contact for Benefit Population (Community FE, First Year Outcomes Only)

	Coefficient estimate (with 95% CI and p-value) on Family Start indicator
Hospitalised for Long Bone Fracture	-0.0006
	[-0.002, 0.001]
	p=0.522
Hospitalised for Intracranial Injury	-0.0009
	[-0.002, 0.000]
	p=0.163
Hospitalised for Maltreatment Related Injury	0.0012
	[-0.002, 0.005]
	p=0.514
Any Notification	0.0062
	[-0.028, 0.041]
	p=0.725
Findings of Emotional Abuse	0.0187**
	[0.003, 0.034]
	p=0.0198
Findings of Physical Abuse	-0.0035*
	[-0.008, 0.001]
	p=0.0961
Findings of Neglect	0.0053
	[-0.01, 0.02]
	p=0.485
Placement Commenced	0.0042
	[-0.004, 0.013]
	p=0.323

Notes: These estimates are from fixed effects regressions with robust standard errors clustered at the TLA level. Regressions control for quarter indicators as well as an indicator for whether the mother was under 18. Outcomes are divided by the total count in the community and thus can be interpreted as changes in the proportion in a community experiencing that outcome (eg. a 1.87 percentage point increase in the proportion of children with findings of emotional abuse by age 1, 95% CI 0.3 to 3.4 percentage points). Parameter estimates statistically different than 0 at 99% (***), 95% (**), and 90% (*) confidence.

5.4 Mortality

Tables 7A and 7B focus on the impact of FS on overall post neonatal mortality, as well as post neonatal mortality caused by SUDI or injury. Focusing first on the PSM results the estimates are negative and significant for all three measures of mortality in the first year of life. Overall FS is estimated to reduce post neonatal infant mortality by 1.6 deaths per 1,000 (CI, 0.5 to 2.6 per 1,000); SUDI deaths by 1.1 per 1,000 (CI, 0.6 to 1.6 per 1,000) and injury deaths by 0.7 per 1,000 (CI, 0.4 to 1.1 per 1,000). FS is also estimated to have a statistically significant impact on all-cause mortality and injury deaths in the second year of life.

The FE community-level results shown in Table 7B line up with these PSM results with an overall estimated reduction in post neonatal infant mortality. The estimates suggest that the introduction of FS reduced post neonatal infant mortality by 3.5 deaths per 1,000 children supported by benefit (CI, 0.3 to 6.7 per 1,000). Impacts on SUDI and first year injury deaths effects are also estimated to be negative, but are not statistically significant.

There is a concern that the estimated PSM effects might be biased by the existence of "competing risks". That is, since children can be enrolled in FS up until the end of their first year of life, there is potential for death rates amongst those enrolled to be lower by the mere fact that in order to enrol at some point in time, an infant would need to have survived up to that point in time. To test whether this "competing risk" accounted for the results, we re-estimated the PSM model using data only for infants who were enrolled before reaching 4 week of age.[44] In this case, all treated and control infants were at equal risk of death. The estimated effects for post neonatal infant injury death and SUDI were similar in size and significance to the baseline results. The effect size for all cause post neonatal infant mortality was smaller. Therefore, the SUDI and injury specific mortality in the first year appears robust to the competing risk hypothesis. Additionally, the significant impacts on all cause and injury mortality in the second year of life (Table 7A, column 2) are reassuring since by this time virtually all FS children were enrolled.

Consistent with Olds et al. (2014), evidence from the PSM for programme impacts is strongest for SUDI and injury deaths. Further exploration of these results is needed with a longer follow-up and larger study population. Appendix D provides additional robustness checks for competing explanations for the mortality impacts with a particular focus on SUDI prevention activities over the period of study. The results remain robust to these additional tests.

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[44]This meant that all children in the treated sample were enrolled in FS before the post neonatal period. Sample size was reduced as a result.

Table 7A: Impact of Family Start on Mortality (Individual PSM)

	Coefficient estimate (with 95% CI and p-value) on Family Start indicator	
	Outcomes in the First Year	Outcomes in the Second Year
Post Neonatal Mortality	-0.0016***	-0.0003*
	[-0.0026, -0.0005]	[-0.0006, 0.0000]
	p=0.003	p=0.052
Post Neonatal SUDI	-0.0011***	
	[-0.0016, -0.0006]	N/A
	p=0.000	
Post Neonatal Injury Death	-0.0007***	-0.0001*
	[-0.0011, -0.0004]	[-0.0003, 0.0000]
	p=0.000	p=0.083

Notes: These estimates are from regressions using propensity score matching utilizing nearest neighbour matching on propensity score, with exact match on ethnic group, rurality, age of mother, child supported by benefit before 13 weeks, whether NZDep 9/10 and year of birth. It compares treated individuals in phased-in TLAS with matched individuals in never-treated TLAs. Results can all be interpreted as the average change in the probability of the outcome occurring as a result of treatment (eg. a 0.11 percentage point or 1.1 per 1000 reduction in the proportion of children who died as a result of SUDI, 95% CI 0.6 to 1.6 per 1000 reduction). Parameter estimates statistically different than 0 at 99% (***), 95% (**), and 90% (*) confidence.

Table 7B: Impact of Family Start on Mortality for Benefit Population (Community FE, First Year Outcomes Only)

	Coefficient estimate (with 95% CI and p-value) on Family Start indicator
Post Neonatal Infant Mortality	-0.0035**
	[-0.0067, 0.0003]
	p=0.036
Post Neonatal SUDI	-0.0006
	[-0.0022, 0.0010]
	p=0.466
Post Neonatal Infant Injury Death	-0.0006
	[-0.0016, 0.0004]
	p=0.251

Notes: These estimates are from fixed effects regressions with robust standard errors clustered at the TLA level. Regressions control for quarter indicators as well as an indicator for whether the mother was under 18. Outcomes are divided by the total count in the community and thus can be interpreted as changes in the proportion in a community experiencing that outcome (eg. an 0.35 percentage point or 3.5 per 1000 reduction in post neonatal infant mortality for benefit children, 95% CI 0.3 per 1000 increase to 6.7 per thousand reduction). Parameter estimates statistically different than 0 at 99% (***), 95% (**), and 90% (*) confidence.

An important question is the mechanism by which FS might have reduced mortality. While we can't disentangle the possible explanations with our data, we discuss possible mechanisms here. One possible explanation is the practical support, advice and encouragement FS workers provide (for breastfeeding, responsive infant care, keeping homes smoke free, reducing home hazards, accessing full welfare benefit entitlements and budgeting services, and addressing substance abuse and family violence for example).[45] This support may have positively impacted the health and safety of children.

A second possible channel is by providing a buffer against the negative effects of stress in the critical periods of pregnancy and the weeks following birth, thus improving the mothers' motivation to care for and protect their children and avoid risk (Olds et al., 2014). A third possibility is that having a FS worker visit the home and the increase in CYF contact that accompanied it may have reduced mortality if it provided greater focus on safety and improved the environment in which children were cared for. Finally, increased exposure to ECE either via participation of older children in the family or via participation of study children in infancy or in their second year may have been protective. ECE might strengthen the social and practical supports parents are able to access, increase the length of time children are away from potentially high-risk home environments, improve parent-child interactions or reduce parenting stress (Robertson, 2014).[46]

The reduction in mortality found in this study is consistent with emerging evidence that pre-natal and post-natal home visiting is a promising means of improving survival in infancy and beyond (Wüst, 2012; Olds et al., 2014; Carabin et al., 2005).

5.5 Sub-group Analysis

We explore results across Māori and Pacific sub-groups. The full set of sub-group results can be found in Appendix Tables E0—E6. Note results for Pacific children include all children with Pacific ethnicity (ie. those who also have Māori ethnicity are not excluded).

Māori (PSM n =1,758 treated 2009-2011 births)

The results for Māori in terms of health service utilisation generally line up with the overall results with some exceptions. The individual PSM results show significant increases in maternal service use, including both addiction and mental health services. In the case of addiction service utilisation, these effects remain significant in the second year variant intended to control for the possibility of reverse causality. Moreover, when we estimate a model on only those families enrolled pre-birth, we find a significant increase in first year utilisation of addiction services for mothers with no use of this service in the year prior to birth. There is no equivalent increase in the use of non-addiction mental health services when we seek to control for reverse causality. Overall, this suggests a positive causal impact of FS on maternal use of addiction services for

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[45]Safe sleep promotion was not mentioned in the programme manual until 2015, but was a focus for FS providers before that time (see Appendix D).

[46]Study children did not qualify for the Early Learning Payment until 18 months of age (in areas where it was available). However, older siblings of the infants studied may have qualified for the payment, and some families may have been supported to enrol their children from before 18 months of age.

Māori children. We cannot rule out the possibility that positive impacts on maternal utilisation of other mental health services are coincidental.

Positive impacts on immunisation are found for Māori children. Enrolment with a PHO at age 1 is reduced by 3.1 percentage points (CI, 0.8 to 5.4 percentage points), however at age 2 we estimate a positive programme impact on PHO enrolment. We were unable to estimate the effect on ECE and B4SC participation because the sample size became too small to find suitable matches.

Results in terms of CYF contact for the Māori sub-population are similar to those for the whole population except that for the second year variant that aims to exclude the possibility of reverse causality, none of the estimated impacts are significant. The concern that first year CYF contact pre-dates FS enrolment is tested by estimating an alternative specification where we look at only those children who were enrolled pre-birth, and outcomes are CYF contact in the first year with no CYF contact pre-birth. Under this specification, we find smaller significant positive impacts on notifications and findings of emotional and physical abuse.

Interestingly, we find a significant reduction in hospitalisation for long bone fracture in the second year of life for Māori children who received FS. While the effect is small (effect size of 1.7 per 1,000 with CI, 0.3 to 3.1 per 1,000), this result hints at improvements in the safety of Māori children.

With the FE estimated at the community level, there are no differences between the overall results and those for the Māori sub-sample in terms of contact with CYF and hospitalisation indicators, except that the small reduction in findings of physical abuse in the overall results is not seen for Māori.

The PSM mortality findings for Maori are in line with those for the overall study population, with significant reduction in post neonatal infant mortality overall and SUDI and injury deaths (these effects are larger than those estimated for the overall sample), and reductions in all-cause and injury mortality in the second year. When we turn to the FE community-level estimates for Māori, these results confirm the reduction in post neonatal infant mortality.

Pacific (PSM n =1,566 treated 2009-2011 births)

In terms of health service utilisation, for Pacific children we see large and significant increases in maternal use of both addiction and non-addiction mental health services in the first year at the individual level which remain significant in the second year when we examine use of mental health services for those who did not uses these services in the prior year. The FE estimates at the community level also suggests positive (but statistically insignificant) effects.

Individual level results for Pacific show positive impacts on immunisation and no significant impact on enrolment with a PHO at age 1 or 2.

We see increased notifications and substantiated findings of physical abuse and neglect in the first year in individual level results. For the second year variant that aims to exclude the possibility of reverse causality, estimated impacts are significant for findings of emotional abuse and neglect and for placement, and effect sizes are reduced. Again, we tested the hypothesis that first year effects reflected CYF contact which predated FS by estimating on only those children who were enrolled prior to birth and by only

counting the outcome where there was no pre-birth CYF contact. In this case, only the notification and emotional abuse findings are significant and the effect size is reduced.

The community level FE results for these outcomes largely align in sign with the individual-level results, but nothing is significant.

In terms of mortality, we see a 2.3 per 1,000 (CI, 0.7 to 3.9 per 1,000) reduction in all cause post neonatal infant mortality at the individual level, and a reduction of 1.4 per 1,000 (CI, 0.1 to 2.8 per 1,000) for SUDI and reduction in injury mortality of 1.1 per 1,000 (CI, 0.2 to 2.3 per 1,000). Community-level FE results show no significant effects.

5.6 Testing Common Trends

In order to interpret the FE results as causal, we need to verify the assumption that prior to a community receiving FS, there was no significant deviation in the trend of each outcome between the treated and the untreated communities. This is sometimes referred to as the "common trends" assumption. To test this assumption we estimate Equation 3, and conduct the joint F-test on the hypothesis that all four-period lead estimates are equal to zero. We only report this test for those outcomes and sub-groups where significant community-level effects were found.

For the benefit population, in the case of emotional abuse findings and post neonatal infant mortality the F-test supports the hypothesis that the lead effects are not different from zero, thus providing further support for a causal interpretation of these estimates. We marginally reject the common trend in the case of findings of physical abuse findings (p=0.095) – suggesting that the decline in physical abuse findings observed in the FE estimates might have been happening in the treated TLAs prior to the introduction of the FS, and therefore we cannot infer the estimated effect to be causal. In the case of the Māori benefit sub-population, the F-test supports the finding that there were no lead effects in the case of post neonatal infant mortality providing support for a causal interpretation and again reinforcing the mortality findings. We marginally reject common trends in the case of emotional abuse findings (p=0.082) suggesting caution is warranted in interpreting these findings.

5.7 Correcting for Multiple Inference

To assess robustness, we next account for multiple inference using the false discovery rate adjusted q-values (analogues to the standard P-value) that limit the expected proportion of rejections within a set of hypotheses that are Type I errors (Anderson, 2008; Benjamini, Krieger and Yekutieli, 2006). We run this test individually for each of the main tables and methods, focusing on the overall results. Key results are robust to this adjustment with a couple of exceptions.   In terms of the PSM results, the impacts on fully immunised at every milestone age become significant at the 5% level in both year 1 and year 2. Placement commenced is no longer significant in the first or second year and findings of physical abuse in the first year and findings of neglect in the second year are now only significant at the 10% level. All of the mortality estimates become significant at the 5% level or less, lending more evidence to the robustness of the PSM mortality impacts. On the FE side, the results on CYF contact and hospitalisation indicators are no longer significant, and the impact on post neonatal mortality loses

significance and is just on the margin of being significant at the 10% level (q=0.122). In summary, the overall message of the paper does not change with these adjustments.

5.8 Summary of PSM Results

Table 8 and Table E7 in the Appendix summarise effect sizes from the PSM using the Cohen's d described above. A value of 0.2 is interpreted as a small effect, 0.5 as a medium effect and 0.8 as a large effect. The effects estimated in this study are small.

Evaluations of home visiting programmes often show modest effects spread across a range of domains. A likely explanation is that the heterogeneity of participating families and their service needs, and variation in the service provided in response, means that large effects on specific outcomes would not be expected. Effective programmes would instead be expected to show a "pattern of small but pervasive benefits" across a range of areas (Fergusson et al., 2012, p. 29). In the Early Start evaluation, effect sizes measured using the Cohen's d were small to moderate – values for improved child outcomes to age 3 were in the range of 0.19 to 0.31, with a median of 0.26 (Fergusson et al., 2012). While differences in the way that outcomes have been measured and defined mean we cannot directly compare results from this study with those for Early Start,[47] the effect sizes we find tend to be smaller.

Despite small effect sizes, the results, particularly those relating to lives saved as a result of the programme, indicate impacts that are materially important.

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[47]For example, the Early Start evaluation examined duration of ECE by 36 months of age where our study examines whether or not the child was engaged in ECE when they participated in the B4SC.

Table 8: Summary of Effects Sizes, Cohen's *d* (Individual, PSM)

	Outcomes in the First Year	Outcomes in the Second Year	Outcomes in the Fifth Year
	Effect (d)	Effect (d)	Effect (d)
Mother Received Addiction Service	**0.07**	**0.06**	N/A
(With No Addiction Service in First Year)	N/A	0.02	N/A
Mother Received Mental Health Service	**0.11**	**0.08**	N/A
(With No Mental Health Service in First Year)	N/A	0.03	N/A
Enrolled with PHO	**0.08**	0.01	N/A
Fully Immunized at 1+ Milestone Age	**0.04**	**0.05**	N/A
Fully Immunized at Every Milestone Age	**0.11**	**0.09**	N/A
Participated in B4SC (2009 Cohort Only)	N/A	N/A	0.03
Attended ECE (for those who participated in B4SC, only for 2009 cohort)	N/A	N/A	**0.09**
Hospitalized for Long Bone Fracture	0.03	0.00	N/A
Hospitalized for Intracranial Injury	0.01	N/A	N/A
Hospitalized for Maltreatment Injury	0.00	0.03	N/A
Any Notification	**0.17**	**0.17**	N/A
(With No Notification in First Year)	N/A	**0.06**	N/A
Findings of Emotional Abuse	**0.13**	**0.14**	N/A
(With No Notification in First Year)	N/A	0.04	N/A
Findings of Physical Abuse	**0.05**	0.03	N/A
(With No Notification in First Year)	N/A	0.03	N/A
Findings of Neglect	**0.09**	0.05	N/A
(With No Notification in First Year)	N/A	0.02	N/A
Placement Commenced	**0.04**	0.05	N/A
(With No Notification in First Year)	N/A	0.01	N/A
			N/A
Post Neonatal Mortality	**0.07**	0.05	N/A
Post Neonatal SUDI	**0.10**	N/A	N/A
Post Neonatal Injury Death	**0.10**	0.04	N/A

Notes: Bolded values indicate effects where parameter estimates from the PSM are statistically different to 0 at >90% confidence.

6. Limitations

There are a number of limitations which need to be considered in interpreting the results of this study. Linking is probabilistic and some errors are inevitable. The data capture only information collected or generated in the process of administering government services, and inevitably embody any errors in measurement, reporting and recording that occur in those processes. Particularly in the case of maltreatment, administrative data do not provide a reliable measure for assessing programme impacts on the incidence of harm as they can be shaped by levels of contact with agency workers which might be altered by a service like FS (Fergusson et al, 2012; Gilbert et al., 2012).

In addition, administrative data currently offer few direct measures of children's cognition and behaviour, parenting behaviours and attitudes, or the home environment. Effects on these outcomes are not able to be established by this study as a result (noting that administrative data on parent reports of child behaviours at the B4SC are available, and examination of these outcomes would be a useful follow-up to this study). Future work that supplements administrative data with interview and direct observation data would be a useful and important addition. It would allow measurement of impacts on a wider range of outcomes, including inter-partner conflict and violence, parental discipline practices, parental mental health. It would also allow incorporation of parents' views of the effectiveness of FS.[48]

In this study, we examine particular birth cohorts, and examine outcomes in infancy and early childhood. Our findings may not be generalizable to other birth cohorts, or to outcomes at older ages. Given the confines of the data linkage, our analysis excludes the experience of children who arrived as migrants, and fails to capture outcomes for children who left the country through outward migration.

Families and regions used as controls may have received alternative services that we have not accounted for. For example, GPs, Well Child/Tamariki Ora providers or other non-Government organisations might have provided similar services in the absence of FS. The beginning of the implementation of the Whānau Ora approach to social service delivery in 2010 may have increased access to other forms of intensive support towards the end of our study period. While we made some efforts to establish that there were no alternative services funded at the same scale with the same target population in untreated areas, we cannot be sure that this is the case. Therefore, estimated effects sizes have to be taken as not reflecting the full impact, but rather the differential impact of the programme.

There are also limitations in the methods that we used. PSM may not have adequately controlled for unobserved selection, particularly community level characteristics. Our examination of the profile of the treated and control sample for the PSM analysis suggested the treated group faced more challenges which would suggest that our estimates of positive impacts might be conservative, and that the size of our estimates showing increased early contact with CYF might overstate true programme impacts. In the community level FE analysis, known programme coverage rates are around 16%, thus making it difficult to draw strong conclusions on programme impacts. Mortality

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[48]To date, no study of FS has independently collected representative data on parent perspectives on effectiveness.

results are also based on very small numbers in some cases, and thus should be viewed with caution. There is also some evidence that competing risks may explain part of the all cause post neonatal infant mortality impacts. Further research with a longer follow-up and larger study cohort is needed to fully understand the impact of FS on mortality, but results from this study are very promising.

Variability in practice and performance across providers has been a recurrent theme in FS evaluations and reviews (Evaluation Management Group, 2003; Centre for Child and Family Policy Research, 2005; Cribb, 2009; Davies, 2013). Individual provider performance is not the focus of this study[49] – the FE study relies on examining data from across groups of providers who started operation at different times, and the strength of the PSM is in identifying large numbers of children who received the programme by aggregating across multiple providers. We are not able to say from our analysis whether all providers generated positive impacts for the families they served. What is clear from sensitivity testing for the mortality results, however, is that no single provider area can account for those results (Appendix D).

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[49]In addition, release of data that could identify individual providers was not permitted under the Statistics New Zealand conditions governing access to the linked data.

7. Relevance to Family Start Today

In a retrospective study such as ours, it is often the case that the programme being studied has adapted and evolved since the period under examination. It is useful to consider whether the impacts estimated would likely be similar to those delivered by the programme in its current form.

Our study examines FS as it was over the period 2005-2012. Between mid-2011 and mid-2012, a number of changes were made to the programme in response to a 2009 review (Cribb, 2009) and 2010 research (Fielding, 2011). These changes were intended to make FS more effective and to strengthen the focus on identifying and responding to child maltreatment (Martin, 2014).

Practice Advisors and a Practice Leader were appointed to support high quality social work practice. New Key Performance Indicators (KPIs) including measures related to children's participation in primary health care services and early childhood education, caseload relative to contracted volumes, frequency of supervision, child safety, and frequency of home visits were introduced. Many of the KPIs required new or revised tools to be used at prescribed frequencies. New contracts set out performance requirements to be measured against the KPIs and penalties for non-performance.   In June 2012, 5 provider contracts across 4 TLAs were terminated and providers in another 11 TLAs were placed on one year contracts in response to performance requirements not being met. From May 2012, referral criteria were modified to more tightly target the programme to high-needs clients.

These changes may have had both negative and positive effects on programme efficacy. The new referral criteria led to families facing a greater number of challenges being referred to the programme.[50] When interviewed in 2014, providers reported a number of difficulties associated with the shift. They reported that engaging and retaining very high-needs clients was problematic, and was not assisted by some of the new more prescriptive requirements for the frequency and content of home visits (Martin, 2014).[51] At the same time, improved support for social work practice and contract management that encouraged high performance is likely to have lifted the quality of the services being provided. Given these changes, it is possible that the current FS is more effective than the programme as it was delivered during the period covered by this study, but our findings are not able to establish this.

There is a need for continuous quality improvement and adaptation in any programme (Olds, 2013). There is also value in taking a systematic, "prevention science" approach to that process (Fergusson et al., 2011). FS is a small programme with a modest

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[50]In randomised controlled trials of the Nurse Family Partnership, programme impacts were larger than average for families with more disadvantaged mothers (Olds, 2002). Positive impacts specific to child abuse and neglect were reduced in families affected by inter-partner violence (Eckenrode et al., 2000). A recent Dutch trial showed reduced exposure to intimate partner violence for disadvantaged young first time mothers (Mejdoubi et al., 2013).
[51]Requirements with respect to the frequency of visits were made more flexible once again in 2015. Where weekly visits in the first three months of service had been a requirement (FaCS, 2012), minimum visit frequency was now fortnightly (Community Investment, 2015). Potential for more prescriptive delivery of home visits to work against client engagement and retention has been highlighted by research examining why Nurse Family Partnership client attrition was substantially higher when implemented in community settings than in the original trials (Olds et al., 2013; Ingoldsby et al., 2013; O'Brien et al., 2012).

funding stream for both delivery of the programme and for programme oversight, programme development and research and evaluation. Nevertheless, the value of investing in evidence and in ensuring that major programme innovations are piloted and trialled before being adopted cannot be overstated. One reading of the history of FS is that a lack of robust evidence on its efficacy has presented a barrier to the adequate resourcing of existing providers and to further expansion of intensive home visiting services in New Zealand.

8. Conclusion

Results of this study affirm the role of intensive home visiting from pregnancy through early childhood as part of a strategy to improve outcomes for disadvantaged children. In the enhanced FS that was rolled out to new areas between 2005 and 2007, mainly qualified workers were employed through a network of local providers to provide a structured programme in a manner that was culturally relevant to their communities and responsive to families' needs. Like the Early Start evaluation, our findings indicate positive impacts on connection to some preventive health services and to early childhood education. Our results also suggest intensive home visiting is a promising means of reducing post neonatal mortality, an outcome that signals improvements in children's environment and care. Effect sizes are small, but nevertheless meaningful. In particular, the higher estimated mortality effect sizes for Māori children suggests that the programme is likely to have accounted for some of the narrowing in ethnic disparity in infant mortality that occurred over the study period.

One concerning finding is a reduction in enrolment with a primary health organisation at age 1 overall and for Māori children. Given the importance of primary health care, this warrants further investigation outside of this study. We find evidence that FS may have brought more children to the early attention of CYF. The Early Start evaluation also suggests such an effect: despite parents in the Early Start group reporting a significantly lower rate of severe physical assault than parents in the control group, there were no differences in rates of agency contact for child abuse and neglect. Whether longer term outcomes were improved for FS children as a result of any increased early contact with CYF should be the subject of future study.

In the near term, there are opportunities to further explore the impact of FS through deeper investigation of the data already assembled for this study. Examples include (i) examination of impacts on other outcomes (eg. parent reports of child behaviour at the B4SC, and frequency of Police family violence referrals made to CYF in respect of the child); (ii) examination of impacts for other client sub-groups (eg. first-born children, children in families with high levels of prior contact with CYF; children in families with access to the Early Learning Payment); and (iii) examination of the context in which positive impacts for Māori children occurred (eg. comparing impacts across different sub-groups of providers).

Taken together with evidence for effectiveness from Early Start and home visiting programmes in other jurisdictions, evidence of positive programme impacts from this study would appear to support further expansion of intensive pre- and post-natal home visiting for disadvantaged families, drawing on current best practice, to families in areas in New Zealand that are as yet unserved, and to greater numbers of families in areas where need outstrips existing service capacity.

While beyond the scope of the current study, estimated impacts such as the reduction in mortality, increased early childhood education participation and increased immunisation could be combined with a simulation of programme impacts in later childhood and information on the direct and indirect costs of the programme to conduct a cost-benefit or cost effectiveness analysis. Such an analysis would inevitably be limited by the outcome data available for study at present, but could allow high-level comparison of FS

with other programmes and services designed to achieve similar outcomes, and inform an assessment of the benefits of further expansion.

We recommend that any further expansion be accompanied by an implementation and evaluation strategy that ensures impacts of an expanded programme on the wellbeing of children and their parents can be demonstrated, ongoing programme innovations have evidence for effectiveness, and between site variation in effectiveness is monitored and evaluated. Ideally this evidence would include both administrative measures of programme efficacy, and direct measures of improved wellbeing, home environment and parenting practice based on observation and interviews with families.

References

Almond, D. and Currie, J. (2011). "Human Capital Development before Age Five". In D. Card and O. Ashenfelter (Eds.). *Handbook of Labor Economics*, Volume 4.

Anderson, M. L., (2008). Multiple inference and gender differences in the effects of early intervention: A reevaluation of the Abecedaian, Perry Preschool, and Early Training Projects. *Journal of the American Statistical Association*, 103, 1481-1495.

Autor, D. H. (2003). Outsourcing at will: The contribution of unjust dismissal doctrine to the growth of employment outsourcing. *Journal of Labor Economics*, 21(1).

Avellar, S., Paulsell, D., Sama-Miller, E., Del Grosso, P., Akers, L., and Kleinman, R. (2014). *Home Visiting Evidence of Effectiveness Review: Executive Summary.* Office of Planning, Research and Evaluation, Administration for Children and Families, U.S. Department of Health and Human Services. Washington, DC.

Benjamini, Y., Krieger, A. and Yekutieli, D. (2006). Adaptive linear step-up procedures that control the false discovery rate. *Biometrika*, 93, 491-507.

Brownwell, M. D., and Jutte, D. P. (2013). Administrative data linkage as a tool for child maltreatment research. *Child Abuse and Neglect*, 37, 120-124.

Carabin, H., Cowan, L. D., Beebe, L. A., Skaggs, V. J., Thompson, D. and Agbangla, C. (2005). Does participation in a nurse visitation programme reduce the frequency of adverse perinatal outcomes in first-time mothers? *Paediatric and Perinatal Epidemiology*, 19(3), 194–205.

Centre for Child and Family Policy Research (2005). *Outcome / impact evaluation of Family Start: Final report*. Auckland UniServices. http://www.msd.govt.nz/about-msd-and-our-work/publications-resources/evaluation/outcome-impact-family-start/index.html

Community Investment (2015). *Family Start Programme Manual*. Wellington. Ministry of Social Development. July.

Cribb, J. (2009). *Review of Family Start and Early Start*. Report prepared for the Minister of Social Development and Employment. www.beehive.govt.nz/webfm_send/4

Currie, J. (2013). ''Big data'' versus ''Big brother'': On the appropriate use of large-scale data collections in paediatrics. *Pediatrics,* 131:S127-S132.

Davies, L. (2013). *Improving Alignment of Family Start and Well Child Tamariki Ora Services*. Report prepared for the Ministry of Health.

Doyle, Jr., J. J. (2008). Child protection and adult crime: using investigator assignment to estimate causal effects of foster care. *Journal of Political Economy*, 116 (4), 746–770.

Drake, B. (1996). Unraveling "unsubstantiated". *Child Maltreatment*, 1(5):261-71.

Duffy, J. D., Hughes, M., Asnes, A. G. and Leventhal, J. M. (2015). Child maltreatment and risk patterns among participants in a child abuse prevention programme. *Child Abuse & Neglect*, 44, 184-193

Eckenrode, J., Ganzel, B., Henderson, C. R. Jr, et al. (2008). Preventing child abuse and neglect with a programme of nurse home visitation: the limiting effects of domestic violence. *JAMA,* 284(11):1385–1391

Evaluation Management Group (2003). *Family Start Process Evaluation Final Report: A Summary and Integration of Components of the Process Evaluation Model*, Ministry of Education, Ministry of Health, and Ministry of Social Development.

Family and Community Services (2009). *Family Start Practice Manual*, July 2009. Wellington, Ministry of Social Development.

Family and Community Services (2012). *Family Start Programme Manual*, May 2012. Wellington, Ministry of Social Development.

Fergusson, D. M., Horwood, L. J., and Lynskey, M. (1994). The childhoods of multiple problem adolescents: A 15-year longitudinal study. *Journal of Child Psychology and Psychiatry, and Allied Disciplines*, 35(6), 1123–40.

Fergusson, D. M., Grant, H., Horwood, L. J., and Ridder, E. (2005). Randomized trial of the Early Start Programme of home visitation. *Pediatrics*, 116(6), e803-e809.

Fergusson, D., McNaughton, S., Hayne, H., and Cunningham, C. (2011). "From evidence to policy, programmes and interventions". In: P. Gluckman and H. Hayne (Eds.). *Improving the Transition: Reducing Social and Psychological Morbidity During Adolescence*. Office of the Prime Minister's Science Advisory Committee, 287-299.

Fergusson, D., Boden, J., and Horwood, J. (2012). *Early Start Evaluation Report: Nine Year Follow-up.* Wellington: Ministry of Social Development.

Fielding, K. (2011). *Research to Inform Improvements to Increase Family Start Effectiveness in Preventing Child Maltreatment and Promoting Child Development*. Centre for Social Research and Evaluation, Wellington: Ministry of Social Development. Unpublished.

Fluke, J. (2009). Allegory of the cave: on the theme of substantiation. *Child Maltreatment,* 14(1), 69-72.

Gilbert, R., Fluke, J., Izquierdo, A., Brownell, M., Gulliver, P., Janson, S. and Sidebotham, P. (2012). Child maltreatment: variation in trends and policies in six developed countries. *The Lancet*, 379, 9817, 758-772.

Glied, S. and Oellerich, D. (2014). Two-Generation Programmes and Health. *Future of Children*, 24(1), 79–95.

Gomby, D. S. (2000). Promise and limitations of home visitation. *Journal of the American Medical Association*, 284(11), 1430-1431.

Yoshikawa, H., Weiland, C., Brooks-Gunn, J., Burchinal, M. R., Espinosa, L. M., Gormley, W. T., Ludwig, J., Magnuson, K. A., Phillips, D. and Zaslow, M. J. (2013). *Investing in Our Future: The Evidence Base on Preschool Education*. Society for Research in Child Development.

Howard, K. S. and Brooks-Gunn, J. (2009). The role of home visiting programmes in preventing child abuse and neglect. *The Future of Children*, 19 (2), 119–146.

Hussey, G., Marshall, J., English, D., Knight, E., Lau, A., Dubowitz, H., and Kotch, J. (2005). Defining maltreatment according to substantiation: distinction without a difference? *Child Abuse & Neglect,* 29(5), 479-492.

Ingoldsby, E. M., Baca, P., McClatchey, M. W., et al. (2013). Quasi-experimental pilot study of intervention to increase participant retention and completed home visits in the Nurse-Family Partnership. *Prevention Science,* 14(6), 525-534.

Irvine, P. (2003). *Family Start: Its Development, Implementation and Evaluation Design*. Unpublished research paper.

Kilburn, M. R. and Karoly, L. A. (2008). *The Economics of Early Childhood Policy: What the Dismal Science Has to Say About Investing in Children*. Occasional papers. RAND Corporation.

MacMillan, H., Wathen, N., Balow, J., Fergusson, D., Levnthal, J., and Taussig, H. (2009). Interventions to prevent child maltreatment and associated impairment. *The Lancet*, 373, 9659, 250-266.

Martin, M. (2014). *How the Family Start Programme is Working for Programme Staff and for Clients with High Needs*. Ministry of Social Development, New Zealand.

Matone, M., O'Reilly, A. L. R., Luan, X., Localio, A. R. and Rubin, D. M. (2012). Emergency department visits and hospitalizations for injuries among infants and children following statewide implementation of a home visitation model. *Maternal and Child Health Journal*, 16(9), 1754-1761.

Matone, M., Curtis, C., Chesnokova, A., Yun, K., Kreider, A., Curtis, M. and Rubin, D. (2013). *Evaluation of Maternal and Child Home Visitation Programs: Lessons from Pennsylvania. Evidence To Action Reprint*. Policylab Center To Bridge Research, Practice and Policy.

Mejdoubi, J., van den Heijkant, S. C. C. M., van Leerdam, F. J. M., Heymans, M. W., Hirasing, R. A., Crijnen, A. A. M. (2013). Effect of Nurse Home Visits vs. Usual Care on Reducing Intimate Partner Violence in Young High-Risk Pregnant Women: A Randomized Controlled Trial. *PLoS ONE*, 8(10), e78185.

Ministry of Social Development (2007). *Family Start Programme Logic*. Unpublished draft.

Ministry of Social Development (2009). *Family Start 12 month performance Report*. Report to the Minister for Social Development and Employment, 13 December 2009.

Ministry of Social Development (2004a). *Criteria for short listing locations for enhanced services based on the FS model,* memo, 13 May.

Ministry of Social Development (2004b). *Budget 2004: Implementation of Enhanced FS*, Report to Minister for Social Development and Employment, 16 August 2004.

Ministry of Health (2009). *Mortality Collection Data Dictionary*, Version 1.3. Wellington: Ministry of Health.

Ministry of Health (2011). *Targetting Immunisation,* Wellington: Ministry of Health.

Morton, S. M. B., Atatoa Carr, P. E., Grant, C. C., Berry, S. D., Mohal, J., and Pillai, A. (2015). *Growing Up in New Zealand: A longitudinal study of New Zealand children and their families. Vulnerability Report 2: Transitions in exposure to vulnerability in the first 1000 days of life.* Auckland: Growing Up in New Zealand.

New Zealand Mortality Review Group (2013). *9th Data Report 2008-2012 and Data Supplement*. Wellington: Child and Youth Mortality Review Committee.

O'Brien, R. A., Moritz, P., Luckey, D. W., McClatchey, M. W., Ingoldsby, E. M., and Olds, D. L. (2012). Mixed methods analysis of participant retention in the Nurse Family Partnership. *Prevention Science*. 13, 219–228.

Olds, D. L., Henderson, C. R. Jr., Chamberlin, R. And Tatelbaum, R. (1986). Preventing child abuse and neglect: A randomized trial of nurse home visitation. *Pediatrics*, 78, 65–78.

Olds, D. L., Eckenrode, J., Henderson, C. R., Kitzman, H., Powers, J., Cole, R. and Luckey, D. (1997). Long-term effects of home visitation on maternal life course and child abuse and neglect. *Journal of the American Medical Association*, 278(8), 637–643.

Olds, D.L. (2002). Prenatal and infancy home visiting by nurses: from randomized trials to community replication. *Prevention Science*, 3(3), 153– 172.

Olds, D. L., Donelan-McCall, N., O'Brien, R., MacMillan, H. L., Jack, S. M., Jenkins, T., Dunlap, W. P., III, O'Fallon, M., Yost, E., Thorland, B., Pinto, F., Gasbarro, M., Baca, P., Melnick, A., and Beeber, L. (2013). Improving the Nurse-Family Partnership in community practice. *Pediatrics*, 132, S110–S117.

Olds, D. L., Kitzman, H., Knudtson, M. D., Anson, E., Smith, J. A. and Cole, R. (2014). Effect of Home Visiting by Nurses on Maternal and Child Mortality Results of a 2-Decade Follow-up of a Randomized Clinical Trial. *JAMA Pediatrics*, 168(9), 800-806.

Olds. D.L. (2015). Building evidence to improve maternal and child health: Comment. *Lancet*, published online October 14.

Peacock, S., Konrad, S., Watson, E., Nickel, D., and Muhajarine, N. (2013). Effectiveness of home visiting programmes on child outcomes: a systematic review. *BMC Public Health*, 13(17).

Putnam-Hornstein, E., Wood, J. N., Fluke, J., Yoshioka-Maxwell, A., and Berger, R. P. (2013). Preventing severe and fatal child-maltreatment: making the case for the expanded use and integration of data. *Child Welfare*, 92(1), 59-75.

Robertson, J. (2014). *Effective Parenting Programmes: A Review of the Effectiveness of Parenting Programmes for Parents of Vulnerable Children.* Social Policy Evaluation and Research Unit Research Report 1/4.

Robling, M., Bekkers, M-J., Bell, K., Butler, C. C., Cannings-John, R., Channon, S., Martin, B. C., Gregory, J. W., Hood, K., Kemp, A., Kenkre, J., Montgomery, A. A., Moody, G., Owen-Jones, E., Pickett, K., Richardson, G., Roberts, Z. E. S., Ronaldson, S. Sanders, J., Stamuli, E.,and Torgerson, D. (2015). Effectiveness of a nurse-led intensive home-visitation programme for first-time teenage mothers (Building Blocks): a pragmatic randomised controlled trial. *Lancet*, published online October 14.

Rubin, D. M., O'Reilly, A. L., Luan, X., Dai, D., Localio, A. R., and Christian, C. W. (2011). Variation in pregnancy outcomes following statewide implementation of a prenatal home visitation programme. *Archives of Pediatrics and Adolescent Medicine*, 165(3), 198-204.

Salmond, C., Crampton, P., and Atkinson, J. (2007). *NZDep2006 Index of Deprivation User's Manual*. Wellington: Department of Public Health, University of Otago.

Simpson, J., Oben, G., Wicken, A., Adams, J., Reddington, A., and Duncanson, M. (2014). *Child Poverty Monitor 2014 Technical Report.* Dunedin. NZ Child & Youth Epidemiology Service, University of Otago.

Tufts Interdisciplinary Evaluation Research. (2015). *The Massachusetts Healthy Families Evaluation-2 (MHFE-2): A Randomized Controlled Trial of a Statewide Home Visiting Programme for Young Parents. Final Report to the Children's Trust of Massachusetts - Executive Summary.* Medford, MA: Tufts University.

Wüst, M. (2012). Early interventions and infant health: Evidence from the Danish home visiting programme*. Labour Economics,* 19, 484–495.

Appendix A. History of the Family Start Programme

FS was first introduced in 1998 in 3 pilot sites and rapidly expanded to another 13 sites in 1999 and 2000. Enhancement of the program and further expansion occurred between 2005 and 2007. Mid-2011 marked the beginning of a further series of changes, including tightened contract management, in response to a 2009 review (Cribb, 2010) and 2010 research (Fielding 2011) (Box 1). By the end of 2007 FS was operating in 30 TLAs. There has been no further expansion of the program since that time.

Box 1. Timeline of FS Expansion

1998: FS pilot established in 3 TLAs: Rotorua, Waitakere, Whangarei.

1999-2000: Expansion to a further 13 TLAs : Dunedin, Far North, Gisborne, Hamilton, Hastings, Horowhenua, Invercargill, Kawerau, Masterton, Nelson, Porirua, Wanganui, Whakatane.

2005-2997: Enhancement and further expansion:

- Q2 2005: 2 TLAs phase in: Auckland and Opotiki
- Q1 2006: 2 TLAs phase in: Lower Hutt, Manukau
- Q3 2006: 4 TLAs phase in: Napier, Taupo, Waikato, Papakura
- Q4 2006: 4 TLAs phase in: Buller, Grey, Hauraki, Wairoa
- Q3 2007: 2 TLAs phase in: South Waikato, Ruapehu.

2012: Some service interruption in 4 TLAs due to termination of provider contracts in June 2012: Porirua, Waitakere, Opotiki, Papakura.

2015: With no further expansion of the programme after 2005-07, there remain 44 TLAs where FS had never been made available

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Core features of the FS programme design have been in place since its inception. However the emphasis, level of support for high quality practice, targeting, monitoring, and contract management have all evolved over time (Box 2 provides a summary). This Appendix provides readers with a detailed description of changes in the FS Programme over three time periods: 1998 – mid-2004: pilot and first expansion; mid-2004 – mid-2011: enhancement and expansion to new areas (this is the period covered by the present study; mid-2011 – 2014: re-focused targeting and contract management.

Box 2. Summary of Programme Evolution

	1998 – Mid-2004 Pilot and first expansion	Mid-2004 – Mid-2011 Enhancement and expansion to new areas	Mid-2011 – 2014 Re-focused targeting contract management
Minimum requirement for frequency of visits	No	Yes (weekly or fortnightly depending on assessed need)	Yes (weekly initially)
Minimum education requirement for FS workers	No	Expected (transitioning)	Expected
Supervision requirements for FS workers	Some	Yes	Yes
Pre-service training for FS workers	Some	Yes	Yes (strengthened)
Fidelity standards for providers	No	Yes	Yes (strengthened)
Systems for monitoring fidelity	No	Yes	Yes (strengthened)
Specified content and activities for home visits	Some	Yes	Yes (standardised tools introduced)

Source for template: http://homvee.acf.hhs.gov/ImpOverview.aspx

A1.   1998 – mid-2004: Pilot and First Expansion

FS was established in three pilot sites in 1998 with funding and governance provided from across health, child welfare and education agencies (Irvine, 2003). It was developed as a response to concerns about intergenerational cycles of disadvantage, gaps in services at the local level, and poor co-ordination of services where they did exist (Irvine, 2003; MoH, 2000; Evaluation Management Group, 2003). The programme was rapidly expanded to another 13 sites in 1999 and 2000. The proposal for expansion suggested that the weight of international evidence and the experience of the Early Start pilot supported the expansion of FS in advance of any evidence for its effectiveness (Irvine 2003). Criteria that informed the selection of new FS providers included a requirement that the provider be culturally representative of their communities. Māori providers were involved in the delivery of the programme in all 16 initial sites (Ministry of Health, 2000).

Programme Design

FS was designed to be targeted at the most at-risk 15% of the population. This threshold was set with the intention of maximising the likelihood that the most at-risk 5% of families would be identified and served by the programme (Irvine, 2003) and making the programme less stigmatising (Ministry of Health, 2000). Referrals were made by an approved referral agency, with the prior consent of the family. Approved referral agencies were initially limited to Lead Maternity Carers, hospital maternity services and Well Child providers. Provision was made to also include referrals from GPs and self-referrals in 2000 (Evaluation Management Group, 2003). Referral criteria that applied in the initial period are shown in Box 3. Presence of any one of the criteria was sufficient for the family to be referred. Referrals could be made from six months prior to the birth of a new baby to six months post-birth (CYF, 1999).

Box 3. Referral Criteria 1998 – 2005 (Evaluation Management Group, 2003)

1. Unsupported parent
2. No or minimal antenatal care
3. Young mother
4. Mental ill-health
5. Substance abuse
6. Family history of abuse
7. Relationship problems
8. Low income status
9. Lack of essential resources
10. Frequent change of address
11. Low maternal educational qualifications
12. Sudden Infant Death Syndrome factors (where not covered by the above 11 criteria)

After referral, a needs assessment was undertaken by the FS provider and, if the family met the criteria, they were invited to participate in the programme and assigned to one of three levels of service intensity. High intensity families were expected to receive up to 240 hours of service during the first year in the programme, medium intensity families up to 150 hours and low intensity families 60 hours of service. Hours of service were expected to reduce during subsequent years in the programme (CYF, 1999).

Guidelines for providers described the services to be delivered in an open and intentionally non-prescriptive way (Box 4). Each provider was free to develop and administer services in a manner that "reflects local need, culture and community" (CYF 1999: 1). There was no requirement or expectation that staff delivering the programme would have formal qualifications.

"The family/whanau worker works with the family to achieve integrated and comprehensive solutions to identified health, educational and social needs. An outline of what this may include follows.

Child Health and Development
- Maintaining a clear focus on the child/children's wellbeing, including the adequacy of care, their physical and emotional health, and age-appropriate development.
- Referring and accessing other agencies where there is a concern for the child's wellbeing or safety.
- Modelling positive parent/child interaction and assisting in the development of good parent/child relationships.
- Ensuring the child is registered with a single General Practitioner to ensure consistency of medical care.
- Assisting mothers in gaining access to and utilising health care for both the infant/child and mother. This may include provision of advice, support, encouragement and transport.
- Providing mothers with advice and support in key areas related to child health goals, including smoking cessation, breastfeeding, immunisation, hygiene, contraception.

Social Needs – Education – Training Opportunities – Employment – Adult Focused
- Providing families with financial and budgeting advice including ongoing money management, advocacy and referrals to budgeting services as required.
- Advocacy regarding housing issues, including overcrowding, sub-standard conditions and insecure tenure.
- Providing support, information, advice and referrals to deal with any legal matters, including custody and access issues, Protection Orders (Domestic Violence Act 1995), outstanding court matters, unpaid fines.
- Providing assistance, advice, information and referrals for issues of: alcohol and drug abuse or dependency, domestic violence, mental health.
- Promoting services and providing information and support that will lead to the parent(s): increasing their confidence and self-esteem; developing their skills; improving their relationships.
- Assisting families to reduce overall stress and build on their strengths and capacities.
- Assisting families to build and strengthen their family/Whānau support and community support networks.

Child Educational Development
- Assisting the parent(s) with advice and support on child development, milestones and age-appropriate activities.
- Delivering the Parents as First Teachers programme (PAFT)."

Evaluation

When Government established FS, it also approved funding for the expansion and randomised controlled trial of the Early Start programme (Irvine, 2003). Initial advice that there should also be a randomised controlled trial of FS was questioned in a series of reports from 1998 (Irvine, 2003) and actively resisted by providers (Centre for Child and Family Policy Research, 2005). In the event, a senior officials group commissioned a process evaluation and a study intended to provide evidence on effectiveness that would have a single group longitudinal design, and no control or comparison group. This decision on study design, together with non-random sample selection of families into the study, meant that the commissioned effectiveness work was unable to determine the impact of the programme (Centre for Child and Family Policy Research, 2005).

The process evaluation examined the operation of FS in the 3 initial pilot sites. It highlighted a number of difficulties with the tendering process for selecting providers, service establishment and staff training and skills, and a need for greater consistency. More than half of the mothers interviewed spoke of positive changes in their own behaviour or changes in their children which they related to the help they had received from FS. Their comments also pointed to the need for trained staff, quality supervision and organisational accountability (Evaluation Management Group, 2003).

A2.   Mid-2004 – mid-2011: Enhancement and Expansion to New Areas

A number of improvements to FS were agreed in late 2003. These were implemented through the revised contracts effective from 1 July 2004 and included:

- introducing training for provider governance and management arrangements
- introducing mandatory qualifications for supervisors and recommending qualifications for FS workers
- requiring that memoranda of understanding be established with CYF
- using a more comprehensive needs assessment tool
- improved measurable indicators relating to the FS outcomes
- introducing a comprehensive and nationally consistent monitoring framework (MSD, 2004b).

In April 2004, Cabinet approved funding to provide enhanced FS in the equivalent of 9 additional locations phased in over the next 3 years. When agreeing sites for the expansion, Ministers confirmed the following enhancements to programme management, delivery and design to ensure that the new FS providers delivered a higher quality service than the existing FS programme:

- strengthened national governance and management arrangements
- a more flexible contract model to allow for annual negotiation on the programme content and annual reviews of performance
- a requirement that FS workers have a formal tertiary qualifications in social work, nursing or early childhood education
- provision for referrals to be accepted from six months prior to birth to one year of age, with discretion for providers to accept referrals from families with a child up to two years of age
- a broadening of the referral criteria to include CYF involvement (see Box 5) and broadening the range of referral agencies to include agencies who have a strong working relationship with the family and a full knowledge of the risk indicators
- encouraging FS workers to work with case managers in other agencies (MSD, 2004b).

These enhancements were informed by the literature on the key features and components of successful programmes, and information from FS contract management and the FS and Early Start evaluations. They were applied to existing providers from 1 July 2005, with provision for transitioning (MSD, 2004b). Families requiring high medium and low intensity continued to be accepted onto the programme. High intensity families required weekly home visits. Medium and low intensity families required fortnightly home visits (MSD, 2009).

In the event, the worker qualifications enhancement was implemented as an expectation rather than as a contractual requirement. Study awards were introduced to increase the number of professionally qualified FS workers (MSD, 2011). Providers were required to report on the qualification and training status of their workers. The transition to a more qualified work force was variable. By July 2008, 63% of FS workers were qualified at diploma level or higher in social work, education or health, 25% were enrolled in study and 12% were not qualified and not studying. One provider reported 11% of its workers were qualified. Another reported 92% of its workers were qualified (Cribb, 2009).

Box 5. Referral Criteria 2005 – Mid-2012 (Family Start Practice Manual, July 2009)

- Unsupported parent - Care-giving parent is a sole parent bringing up the child in the absence of a cohabiting partner or other significant parental or whānau support.
- No or minimal ante-natal care - No, or late, ante-natal care.
- Young parent - Parent is less than 18 years.
- Mental health needs - Parent has a current or historical mental health problem.
- Substance abuse - Caregiver or partner has a problem with alcohol or illicit drug use.
- Family history of abuse - Either parent was abused or has abused previous children.
- Relationship problems - There is evidence of any significant relationship problems or difficulties with partner.
- Low income status - The family has low income eg in receipt of income support or low wage.
- Lack of essential resources - Either the family's housing situation is unstable or unsuitable, or the family has no access to a telephone or transport; or the family lacks basic amenities.
- Frequent change of address - Caregiver/s changed address more than twice in the last 12 months.
- Low parental educational qualifications - The parent or caregiver lacks qualifications or has literacy and/or numeracy difficulties.
- SIDS risk factors - The mother smoked while pregnant; or baby has not been breast-fed, or has only been breast-fed for a short period, or the baby was of low birth weight or premature.
- CYF involvement - One or more children in the family or whānau have been removed from the family by Child, Youth and Family, either historical or currently.

Expansion to New Areas

Locations for the expansion were selected by first identifying the TLAs not already served by FS or Early Start where more than 15% of births in 2002 were to families resident in high deprivation areas.[52] TLAs with cities and towns with the highest number of such births were then prioritised. The resulting listing of TLAs agreed in late 2004 were: the Far North (in this case, the TLA was already served by a provider in Kaitaia, and the expansion located a

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[52]Defined as being resident in a NZDep10 area based on the 2001 version of the index.

second provider in Kaikohe), Auckland, Manukau, Papakura, Opotiki, Ruapehu, Waikato, South Waikato, Taupo, Napier, and Lower Hutt (MSD 2004b).

Consideration was subsequently given to how best to deliver intensive home visiting to areas with small numbers of vulnerable families (MSD 2004b). As a result of that work, 4 additional rural TLAs were included in the list of expansion areas: Wairoa, Hauraki, Buller, Grey.[53] At the time, there were few programmes other than FS and Early Start that provided comparable services at the same level of intensity. Whānau Toko I Te Ora, delivered by the Māori Women's Welfare League, was the exception, but numbers of whānau served were very small, and spread over a wide geographic area (MSD 2004a).

There is limited information on the reasons for the sequencing of TLAs in the progressive roll-out. Auckland, Manukau, Opotiki, and Lower Hutt were selected to be first because there already existed providers with the capacity to deliver enhanced FS (MSD 2004b). Providers in these TLAs began accepting clients in Q3 2005 (Auckland, Opotiki) and Q1 2006 (Manukau, Lower Hutt). The 4 rural TLAs were selected later and, as a result, began service late in the roll-out (Q4 2006). Factors that determined sequencing for the remaining TLAs are not clear from the documents available to us. Figures A1 and A2 show the way in which caseloads built over time, numerically, and as a proportion of contracted volumes. Caseload volumes for treated pre-2001 TLAs averaged 3,000 families over the period.

Early Learning Payment

Between 2005 and 2006, an enhancement to FS was progressively rolled out in some of the TLAs where FS or Early Start had operated since prior to 2001. An "Early Learning Payment" (ELP) paid directly to a licensed early childhood education centre was made available: from December 2005 in Rotorua, Horowhenua, Hamilton, Hastings, Gisborne, Kawerau, and Christchurch (Early Start); from March 2006 in Wanganui and Nelson; from July 2006 in the Far North (Kaitaia only) and Invercargill; from October 2006 in Waitakere, Dunedin, Whangarei, Masterton, Porirua, and Whakatane.

The aim of the payment was to remove the financial barrier for FS and Early Start families to participate in early childhood education. An evaluation showed ELP to be working satisfactorily, with some administrative improvements needed (MSD, 2008). The introduction of the payment was associated with an increase in the percentage of eligible children attending early childhood education. In February 2007, half of all children eligible for the ELP were attending early childhood education subsidised by the ELP (403 payments were in force) (MSD, 2008). The payment is available to children aged 18 – 36 months. It is seen as useful for promoting client retention (Personal correspondence, Community Investment, MSD). In October 2008, it was extended to the first four phase-in TLAs (Auckland, Manukau, Opotiki, Lower Hutt). It has never been extended to remaining phase-in TLAs and remains complex to administer. In 2012, numbers of parents receiving ELP averaged 815 (personal correspondence, MSD).

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[53]The tender process to select providers for these areas commenced in September 2005 and included the Waitomo TLA (Family and Community Services, Ministry of Health and Ministry of Education, 2005). It is not clear from the documents available to us why the programme was not ultimately introduced in Waitomo.

Figure A1: FS Caseload by Quarter First Served, Phase-in TLAs

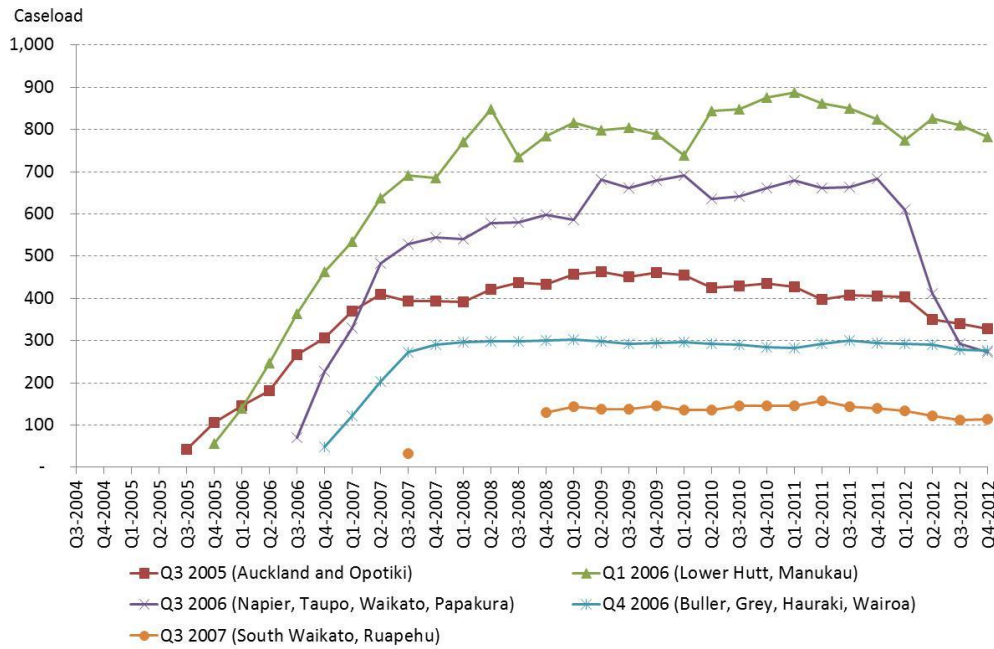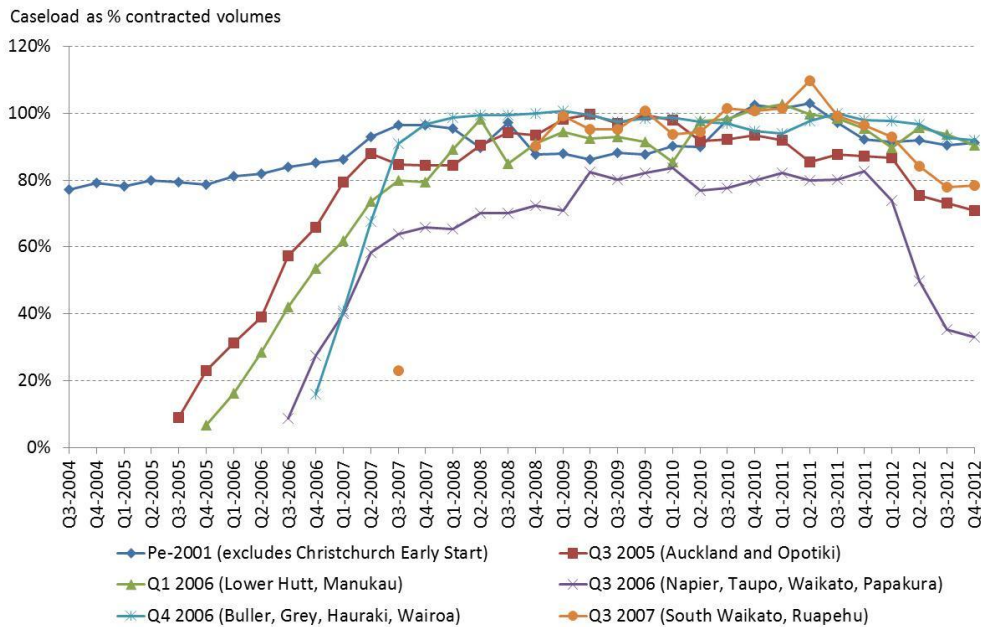**Figure A2: FS Caseload as % Contracted Volumes by Quarter First Served, Phase-in and Treated Pre-2001 TLAs**

Sources: Monthly Monitoring Reports September 2004 – September 2008; FS-Net data December 2008- December 2012.Note: Initial Monthly Monitoring Reports for South Waikato and Ruapehu were not able to be found. Q3 2007 caseload is estimated from the number of client entries reported in Quarterly Monitoring Reports.

Single-agency Funding and Governance

Contracts for all phase-in sites were managed by the Ministry of Social Development. In 2006, health funding for intensive home visiting was transferred to the Ministry of Social Development, and in 2007, education funding and the resources to deliver the parent education aspects of FS were similarly transferred. Cross-agency funding and governance ceased. Programme over-sight and contract management for all FS providers now sat with the Ministry of Social Development.

The Introduction of FS-Net

In October 2008, a new internet-based case management and monitoring and reporting system known as FS–Net was introduced. This provided the vehicle for MSD's monitoring and reporting functions. In 2009, MSD used the first 6 months of FS-Net data to provide a national picture of the families entering FS, performance results for service quality indicators and progress results for children (MSD, 2009).

Evaluation, Research and Review

A study completed in 2007 examined factors that contribute to successful delivery of FS based on interviews with families who had successfully graduated or were making good progress. The study was intended to inform a subsequent impact evaluation. A methodology for the impact evaluation was developed but, given the expense and the potential for new data from FS-Net, did not to proceed (Cribb, 2009).

In late 2009, Government commissioned an independent review of the FS and Early Start programmes. The "Cribb Review" affirmed the need for a home visiting programme for high-risk children as part of an evidence-based system of services to improve child wellbeing. It confirmed that FS had many of the design features needed for an effective early intervention service, but highlighted variation in performance across FS providers, and pointed to improved contract management as a means of addressing poor performance and exiting poorly performing providers. It recommended that once programme fidelity increased and evaluation was undertaken to show the effectiveness of service delivery at the local level, Government should consider increasing volumes at site level and expanding the number of sites operating around the country (Cribb, 2009).

Studies completed in 2010 and 2011 included analysis of how the new FS-Net referral criteria data could be used to profile sub-groups of families, research on reaching and engaging with high-needs families (MSD, 2011), and research to inform programme improvements intended to increase FS effectiveness in preventing child maltreatment and promoting child development (Fielding, 2011).

A3. Mid-2011 – Present: Re-focused Targeting and Contract Management

In 2011 Government directed MSD to undertake a programme of work to make FS more effective and strengthen the focus on identifying and responding to child maltreatment. Changes included revised referral criteria to more tightly target the programme to high-needs families (effective from May 2012, Box 6), all of whom were expected to require a

high intensity of service and weekly visits on entry to the programme. Other changes included the following.

- Key Performance Indicators (KPIs) were introduced in a phased approach in the second half of 2011. These included measures of child participation in immunisation, developmental checks, Well Child/Tamariki Ora checks and early childhood education, and measures of caseload relative to contracted volumes, frequency of supervision, timeliness of development and review of family plans, child safety, and frequency of home visits. Many of the new KPIs required new or revised tools to be used at prescribed frequencies, including a Child Safety Tool drawn from Early Start.
- Contracts were standardised across providers, and set out performance requirements to be measured against the KPIs and penalties for non-performance.
- Practice Advisors, led by a Practice Leader, were appointed to support high quality social work practice (Martin, 2014).

Box 6. Referral criteria from mid-2012 (from the Family Start Programme Manual, May 2012 and an online referral Guide[54])

Families experiencing at least one of these high needs criteria:	• young parents (under 18 years of age) who are experiencing an additional challenge or need • those with mental health issues • those experiencing difficulties with drugs, alcohol or gambling • parents with a childhood history of abuse • a care or protection history for other children • relationship problems • concerning child health and developmental issues.
OR A referral can also be made, as an exception, when the criteria above are not met. Referrers are asked to explain why an exception should be made by indicating what needs there are based on a combination of the additional indicators as listed below:	
Families experiencing more than one of the following indicators:	• a lack of positive support networks • a lack of financial and material resources • frequent change of address • low parental education • sudden unexplained death in infancy (SUDI) factors • criminal justice involvement

Five provider contracts across 4 TLAs were terminated under the new contracts in June 2012. The resulting service interruption is apparent in Figures A1 and A2. Providers in another 11 TLAs were placed on one year contracts in response to performance requirements not being met. In early 2012, providers were preparing for the change in referral criteria by exiting families of especially low need and by screening more robustly for high needs with new families being referred to the programme (MSD, 2012).

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[54]http://www.familyservices.govt.nz/documents/working-with-us/programmes-services/early-intervention/new-family-start-march-2012/family-start-referral-guide.pdf

Evaluation and Research

An examination of alignment between FS and Well Child/Tamariki Ora was undertaken as part of the programme of work to make FS more effective. This study highlighted variation in the degree to which the two services worked in a co-ordinated way to provide universal and more targeted support. Co-located services had the best working relationships (Davies, 2013). Ten providers deliver both FS and Well Child/Tamariki Ora.

Further work aimed at determining what, if any, further changes were required to ensure FS was fit for purpose and able to achieve positive outcomes for vulnerable children was commissioned in 2014. Phase one of the work included further analysis of FS-Net data (Ryan and Martin, 2015) and interviews with providers and families, with a particular focus on the effects of changes to the referral criteria, and the new tools and reporting requirements introduced in 2012 (Martin, 2014). The present study constitutes a second phase of the commissioned work.

Phase one identified a number of challenges for providers associated with the shift to serving families with higher levels of need without any adjustment to funding, training or contracted volumes (Martin, 2014). Programme acceptance and retention rates were especially low for families referred by Police or a local family violence forum (Ryan and Martin, 2015).

Very high needs families were recruited by FS providers to be interviewed as part of the phase one work (n=21). These clients were consistently positive about their experiences of FS, and particularly valued the child development and parent education curriculum Āhuru Mōwai/ Born to Learn. Clients articulated the increased awareness of the importance of parenting practice that they gained from the curriculum (Martin, 2014).

Family Start in 2015

In 2015, FS was delivered by 32 providers across 30 of the 2006 TLAs. Early Start continued to operate in the Christchurch TLA. The proportion of FS workers with tertiary qualifications was 85% (81% in social work, 21% in education, and 17% in health-related fields - some had multiple qualifications). Contracted volumes totalled 5,168 (excluding Early Start). Annual per family funding was $5,700. The total cost of funding to providers (excluding Early Start) was $m28.6 (personal communication, Community Investment, MSD).

References

Centre for Child and Family Policy Research (2005). *Outcome / Impact Evaluation of Family Start: Final Report. Auckland UniServices*. http://www.msd.govt.nz/about-msd-and-our-work/publications-resources/evaluation/outcome-impact-family-start/index.html

Child Youth and Family (1999). *Family Start Guidelines*. Wellington. Child Youth and Family.

Cribb, J. (2009). *Review of Family Start and Early Start.* Report prepared for the Minister of Social Development and Employment. www.beehive.govt.nz/webfm_send/4

Davies, L. (2013). *Improving Alignment of Family Start and Well Child / Tamariki Ora Services*. Report prepared for the Ministry of Health.

Evaluation Management Group (2003). *Family Start Process Evaluation Final Report: A Summary and Integration of components of the process evaluation model,* Ministry of Education, Ministry of Health, and Ministry of Social Development. https://www.msd.govt.nz/documents/about-msd-and-our-work/publications-resources/archive/2003-family-start-process-evaluation-report.pdf

Family and Community Services, Ministry of Health and Ministry of Education (2005). *Family Start Expansion Programme: Information for Communities and Interested Parties*.

Family and Community Services (2009). *Family Start Practice Manual*, July 2009. Wellington, Ministry of Social Development.

Family and Community Services (2012). *Family Start Programme Manual*, May 2012. Wellington, Ministry of Social Development.

Fielding, K. (2011). *Research to Inform Improvements to Increase Family Start Effectiveness in Preventing Child Maltreatment and Promoting Child Development*. Ministry of Social Development. Unpublished.

Fergusson D, Boden J, and Horwood J. (2012). *Early Start Evaluation Report: Nine Year Follow-up*. Wellington: Ministry of Social Development. 2012. www.msd.govt.nz/documents/about-msd-and-our-work/publications-resources/evaluation/early-start-evaluation-report-nine-year-follow-up.pdf

Irvine, P. (2003). *Family Start: Its Development, Implementation and Evaluation Design.* Unpublished research paper.

Martin, M. (2014). *How the Family Start Programme is Working for Programme Staff and for Clients with High Needs. Ministry of Social Development*, New Zealand. http://www.familyservices.govt.nz/documents/working-with-us/programmes-services/early-intervention/new-family-start-march-2012/family-start-phase-1.pdf

Ministry of Social Development (2009). *Family Start Performance Report: Preliminary Results*. Unpublished.

Ministry of Social Development (2011). *Family Start: What We Know*. Research Snapshot. Unpublished.

Ministry of Health (2000). *Family Start Report to Joint Ministers*. 18 October 2000. File Ref: AD40-50-2-17-2

Ministry of Health (2001). *FS Update for Health, Education and Social Service Ministers*. 19 December 2001. File Ref: AD40-50-2-17-2.

Ministry of Social Development (2004a). *Criteria for Short Listing Locations for Enhanced Services Based on the FS Model*, memo, 13 May.

Ministry of Social Development (2004b). *Budget 2004: Implementation of Enhanced FS,* Report to Minister for Social Development and Employment, 16 August 2004.

Ministry of Social Development (2008). *Evaluation of the Early Learning Programme*. Unpublished.

Ministry of Social Development (2012). *Making Family Start More Effective: Update on Progress*. Report to the Minister for Social Development, 24 February.

Ryan, J. and Martin, M. (2015). *Family Start: A Cohort Study.* Ministry of Social Development. Unpublished.

Appendix B. Data Linkage

The present study re-uses a linked administrative dataset formed in the course of a previous research study focused around early childhood (MSD, 2014). Reflecting the evolution of that previous research, this "Integrated Child Dataset" (ICD) was constructed in stages using a range of linkage methods.

B1. Linkage of Health Data

Ministry of Health Maternity Collection (Ministry of Health, 2011a) records in the ICD for baby-mother dyads form the "spine" of the present study. Before being passed into the ICD, Maternity Collection and other health data were linked by the Ministry of Health using the National Health Index number (NHI number), a unique identifier that is assigned to every person who uses health and disability support services in New Zealand (Ministry of Health, 2009a). Other health data linked to the baby-mother Maternity Collection records included:

- records for the child from the National Immunisation Register (Ministry of Health, 2014a)

- hospitalisation records for the child from the National Minimum Dataset (Ministry of Health, 2015)

- records of the child's enrolment with a PHO (Ministry of Health, 2011b)

- B4SC data for the child (Ministry of Health, 2014)

- mortality records for the child from the Mortality Collection (Ministry of Health, 2009b)

- maternal use of publicly funded community based mental health services from PRIMHD (Ministry of Health, 2010)

- maternal use of pharmaceuticals used solely to treat substance abuse and other mental health disorders (Ministry of Health, 2012).

System experts at the Ministry of Health derived a number of the variables that are used in the present study (eg. immunisation completion at given milestone ages, injury hospitalisation by given ages, maternal use of community-based drug and alcohol and other mental health services in years prior and post the birth of the child).

B2. Linkage of Health Data with Data from Other Systems

These linked health records (excluding the NHI) were then probabilistically linked by MSD with records held in other national systems using names and dates of birth and other identifying variables (New Zealand does not have a unique person identifier that applies across all interactions with Government services). The other national systems in the linkage included those for administering:

- birth notifications and registrations and death registrations (Department of Internal Affairs) (Statistics New Zealand, 2013)

- welfare benefits (Ministry of Social Development) (Ministry of Social Development, 2012a)

- child welfare (care and protection) services and youth justice services administered by CYF (Ministry of Social Development) (CYF, 2014)

- corrections sentences served (Corrections Department) (Statistics New Zealand, 2014).

A data linkage algorithm was written to match the data. For children, records were linked within systems (to de-duplicate) and across systems where all of the following criteria were met:

- there was an exact match on the child's date of birth

- there was a high level of agreement on the child's given names

- there was a high level of agreement on the child's surname

- there was an exact match on the first given name of at least one of the parents or caregivers.

Child records were also linked where the above criteria were not met but the probability of the data relating to the same child was high. This allowed a child's records to be linked across systems where, for example:

- they had the same birthdate and similar names in the two systems (but not sufficiently similar to meet the criteria above)

- they had a similar birthdate in the two systems (or birthdate was missing in CYF data) but all the other criteria above were met

- caregiver information was missing in CYF data but all the other criteria above were met.

Parents and caregivers' records were linked within and across data bases where there was:

- an exact match on the date of birth

- an exact match on the first given name

- a high level of agreement on the surname (which provided for inspection of both the parent's current name and name at birth recorded in birth registration data, and aliases recorded in the different systems).

Linkages for parents and caregivers were also made where one of the match criteria above was not met but the others were met and other information could be used to confirm the match. For example:

- in the case of de-duplication within benefit data, a common unique identifier, phone number or address recorded for two records was used to confirm a link where, for example, names agreed but the birth date did not agree

- when linking Corrections data with benefit and CYF data, a common address in the two systems being compared was used to confirm a link where, for example, the date of birth agreed but one of the names did not agree.

B3. Adding FS Enrolment Data to the Linkage

FS enrolment data from FS-Net were added to the linkage at a later stage using SAS DataFlux linkage software. This linkage took a more conservative approach than the linkage algorithm developed for the other probabilistic linkage (ie. it has a lower tolerance for false-positive matches). It required either full correspondence on date of birth and name (or an alias, allowing for transliteration and small differences in the ordering or spelling of names), or small differences on either date of birth or name variables, so long as there was exact correspondence on one or other of the variables.

For each engagement recorded in FS-Net, the youngest child was taken to be the reference "FS" child. If a record in the wider linked data could be found for this child, they were considered matched. If a match could not be made for the reference child but could be made for the primary caregiver identified in FS-Net, birth records for that caregiver were searched and the child with a birthdate closest to the start date for the FS engagement was assumed to be the reference child, and the child was considered matched. Only FS-Net records where a linked record for the reference child could be found in the wider linkage were kept.

Appendix Table B1 shows the rate at which FS-Net records for an engagement could be successfully linked to a child identity in the wider linked database in a prototype version of the linkage. It examines the 15,934 FS-Net engagement starts recorded for the calendar years 2009, 2010 and 2011, by whether the engagement involved a family being:

- accepted onto the programme

- declined (which could occur because the family was assessed not to meet the eligibility criteria or because the family did not give their consent)

- referred only (with no record that the family was either declined or accepted onto the programme, suggesting no contact was made).

In 64% of cases overall, records for a reference child for an engagement recorded in FS-Net could be successfully linked to a child identity in the linked database. The match rate was higher for engagements where the family was accepted onto the programme (84%) and low for declined (15%) and referral only (10%) engagements (Appendix Table B1).

	Number of engagements	Share (%) total engagements (column pct)	Number engagements able to be matched	% Engagements able to be matched (row pct)
Accepted onto programme	11408	72%	9552	84%
Declined (contact made)	3584	22%	548	15%
Referral only (no contact made)	942	6%	97	10%
Total	15934	100%	10197	64%

The main barrier to successful linkage was either the child or the caregiver's identity details not being fully recorded in FS-Net. This occurred most frequently in the case of engagements that were declined or referral only.

After linkage, identifying details (names and exact dates of birth) were removed so that the data were anonymised before analysis.

B4.   Assessing the Quality of the Linked Data

For two earlier studies, clerical checks were undertaken to assess the quality of the linkages formed using the linkage algorithm developed for the probabilistic linkage outlined above. (These checks did not consider the accuracy of the linkage of health records based on NHI number or the linkage of FS data applied using SAS DataFlux).

The first clerical check examined the quality of linkages formed within and across the Ministry of Social Development data bases for a stratified random sample of records for children born in 1993 (MSD, 2012b). The checking was carried out by experts in the respective databases (n = 500 for the checking against benefit databases; n = 350 for the checking against CYF data). Checkers were supplied with records of the linkages obtained from the linkage algorithm for the sample and asked to review whether, on clerical inspection of relevant records, they agreed with the linkages formed. Checkers were also asked to search the relevant systems for missed matches. The checking process involved working through a wider range of data than that used in the electronic matching, and in the case of checking against CYF data, included reviews of case notes, family group conference plans and court plans.

There was a very high rate of agreement between the data linking algorithm and the linkage which would be arrived at on clerical inspection, with linkage errors generally found in not more than 2% of cases. However, for 13.8% of sampled CYF records for which the data linking algorithm linking found no corresponding record in benefit data, on clerical inspection there was in fact a corresponding benefit record (95% CI, 8.8–20.2%) – this equates to a false negative rate of 1.4% for non-matched child benefit records (95% CI 0.9–2.0%).

Failure to find a match for these records reflects their nature. They were generally cases in which the information provided to CYF was incomplete, imprecise, or inaccurate. Many involved third party notifications where, after an initial assessment, it was decided that no

further action was required. The information about the child's identity provided by the party making the initial notification often omitted or estimated key information (such as date of birth), or was subject to some inaccuracy (for example, in the reporting of the child's name).

Although these missed matches represented a source of bias, the number of CYF records for which the electronic linking found no corresponding record in benefit data was small overall (3,090 out of the estimated 76,000 individuals in the 1993 cohort analysed), as was the estimated total number of missed matches (just 430 for the 1993 cohort). As a result, adjusting to take account of these missed matches made only a marginal difference to estimates of the prevalence of contact with each agency (MSD, 2012b). However, the linked data provided conservative estimates of the extent to which CYF clients also appeared in benefit data.

The second clerical check (MSD, 2014) examined the quality of the linkage of benefit, CYF, Corrections and birth registration data bases for a stratified random sample of records for children born in 2010 who had a record in one of the relevant data bases before reaching 3 months of age. The same approach to checking was applied. In the vast majority of cases, the linkages formed for the children agreed with those arrived at on clerical inspection (99.6% agreed, 95% CI, 97.5 - 100.0, n = 527).

All the errors found on clerical inspection of the child records involved missed linkages. While no false positive matches were found, a small number of cases were uncovered in other examination of the data (for example, information for twins was erroneously linked where the children had the same given name, different middle names, and same surname).

The accuracy of the links for associated adults was checked for one in five children in each of the strata of child records sampled (176 parents or caregivers). When looking at the accuracy of the links for a child and all the adults associated with them, the rate of agreement with links arrived at on clerical inspection was lower at 93.8% (95% CI 80.4 – 98.8, n = 96). The lower accuracy reflects the increased likelihood that any one of the people involved could have had an error in the data linkage, and the higher rate at which errors were found for the adults reflecting their longer, and in some cases more complex, histories.

For the adults, errors found included false positive linkages where one individual's information was erroneously linked to another individual (these were found for four of the 176 adult linkages checked), and missed matches (found for two of the 176 adult linkages checked).

References

Child Youth and Family (2014). *Key Statistics and information for media*. Retrieved from http://www.cyf.govt.nz/about-us/who-we-are-what-we-do/information-for-media-backup.html#FrequentlyAskedQuestions10

Ministry of Health (2009a). *National Health Index Data Dictionary*. Version 5.3. Wellington: Ministry of Health.

Ministry of Health (2009b). *Mortality Collection Data Dictionary*. Version 1.3. Wellington: Ministry of Health.

Ministry of Health (2010). *Programme for the Integration of Mental Health Data (PRIMHD) Data Dictionary and Datamart Diagram*. Version 4.0. Wellington: Ministry of Health.

Ministry of Health (2011a). *National Maternity Collection Data Dictionary*. Version 1.0. Wellington: Ministry of Health.

Ministry of Health (2011b). *Primary Health Organisation Enrolment Collection Data Mart Data Dictionary.* Version 1.2. Wellington: Ministry of Health.

Ministry of Health (2012). *Pharmaceutical Claims Data Mart Data Dictionary*. Version 4.1. Wellington: Ministry of Health.

Ministry of Health (2014). *Well Child/Tamariki Ora Programme Practitioner Handbook - Supporting Families and Whānau to Promote their Child's Health and Development*, Revised 2014. Wellington: Ministry of Health.

Ministry of Health (2014a). *Immunisation Handbook 2014*. Wellington: Ministry of Health.

Ministry of Health (2015). *National Minimum Dataset (Hospital Events) Data Dictionary*. Version 7.6. Wellington: Ministry of Health.

Ministry of Social Development (2012a). *Statistical Report for the Year Ending 2011.* Wellington: Ministry of Social Development. Retrieved from http://www.msd.govt.nz/about-msd-and-our-work/publications-resources/statistics/statistical-report/statistical-report-2011.html

Ministry of Social Development (2012b). *Children's Contact with MSD Services*. Wellington: Ministry of Social Development.

Ministry of Social Development (2014). *The Feasibility of Using Predictive Risk Modelling to Identify New-born Children who are High Priority for Preventive Services*. Wellington: Ministry of Social Development

Statistics New Zealand (2013). *DataInfo: Births*. Retrieved from http://datainfoplus.stats.govt.nz/Item/nz.govt.stats/24f68263-9666-4dca-b5d8-c1bc4bef92c4

Statistics New Zealand (2014). *Criminal Conviction and Sentencing Statistics*. Retrieved from http://www.stats.govt.nz/tools_and_services/nzdotstat/justice-statistics-fiscal-year.aspx

Appendix C. Variable Definitions

In all cases, the mother is as recorded in the Ministry of Health Maternity Collection (MAT).

Control, sub-group, matching and descriptive variables
TLA (Mother_TLA) TLA based on mother's domicile code (area unit) at birth event – from MAT.
Birthyear (birth_year) Based on birth date of child in MAT.
Birthquarter (birth_quarter) Based on birth date of child in MAT.
Child supported by welfare benefit within 13 weeks of birth (child_supp_by_ben_within_13w) Only includes children supported by main welfare benefits (eg Unemployment Benefit, Domestic Purposes Benefit). Based on MSD welfare benefit data.
Enrolled in FS (received_FS) Child born 2009-2011 and recorded as having been accepted onto the FS programme, where the identity of the child recorded in FS-Net was able to be linked to a child in the study population and the last action date was greater than the accepted date (ie. the spell of FS had positive duration). Based on MSD FS-Net data. Note in a prototype linkage, we could not find linked identities for 16% of FS engagements. Children resident at birth in an area not served by FS may have received FS if they moved to a FS area after birth, or if providers provide service to families outside their contracted areas.
NZDep9 (m_NZDep_of_AU_at_birth_9) Child resident in NZDep9 area unit based on child's domicile code (area unit) at birth event. From MAT.
NZDep10 (m_NZDep_of_AU_at_birth_10) Child resident in NZDep10 area unit based on child's domicile code (area unit) at birth event. From MAT.
Indicators for urban, semi-rural, rural and remote rural (urban_rural1, urban_rural2, urban_rural3, urban_rural4) Based on the rural/urban status of the mother's residential address at the time of delivery. From MAT. (MOTHER_RURAL_URBAN_STATUS: 0 = Urban 1 = Semi Rural 2 = Rural 3 = Remote Rural.) Note At the time of writing, this variable was known to disproportionately attribute urban status where an address could not be readily matched to an area unit code (eg in the case of a rural delivery (RD) address). The accuracy of the matching and sub-group analysis is constrained by this data limitation.
Female child (m_female_child) Based on prioritised gender information looking across collections – birth registration information is prioritised where available.
First child (m_first_child) Child is oldest child in a family supported by benefit. All children in a multiple birth grouping where no older children are counted as first children. Based on MSD welfare benefit data on the composition of the family at the child's first inclusion in benefit. Note not all children have contact with benefits.
Mother notified to CYF before age 18 (m_mother_notif_b4_18) Notifications include care and protection notifications and Youth Justice referrals. Based on MSD CYF data. Note older CYF records are incomplete so this measure likely understates maternal CYF involvement, more so for older mothers.
Mother in CYF placement before age 18 (m_mother_placement_b4_18) Mother had a care and protection or Youth Justice placement recorded before 18 years of age Based on MSD CYF data. Note older CYF records are incomplete so this measure likely understates maternal

placement history more so for older mothers.

Other children with CYF notifications or CYF Police family violence contact records in the last 5 years (m_oth_ben_chd_not_PFVcont_last5y) Other children who had been notified to CYF in the last 5 years or had a police Family Violence contact record in CYF data in the last 5 years were included in benefit with the mother in the 5 years prior to the child's birth date (where the start date for the CYF event was while the other child was in the mother's care) or included in benefit with the mother on the child's birth date. Note older CYF records are incomplete so this measure likely understates CYF involvement, more so earlier cohorts.

Other children with CYF Police family violence notifications or contact records in the last year (m_oth_ben_chd_PFVnotcont_last1y) Other children who had a police Family Violence notification or contact record in CYF data in the year prior to the child's birth date were included in benefit with the mother at the child's birth date.

Other children with CYF placement in the last 5 years (m_oth_ben_chd_placement_last5y) Other children who had been subject of a CYF care and protection or Youth Justice placement in the last 5 years were included in benefit with the mother in the 5 years prior to the child's birth date (where the start date for the CYF event was while the other child was in the mother's care) or included in benefit with the mother on the child's birth date. Note older CYF records are incomplete so this measure likely understates CYF involvement, more so earlier cohorts. Note when a child or young person is placed in the custody of the Chief Executive of the Ministry of Social Development, a placement record must be created to record that child or young person's primary living arrangement. In a small number of cases, placements are recorded when the child is not in the care of the Chief Executive, or the child is care of the Chief Executive and no placement is recorded.

Mother singleat child's birth (m_mother_single_at_birth) Where either:
- the mother was recorded in benefit data as unpartnered as at the date of the child's first inclusion in benefit and the child was included in benefit within 91 days of birth,
- the father was not recorded on the birth registration, or
- the parents' relationship with each other at the time of the child's birth is recorded on the birth registration as "NO" (NO = Not married or in a civil union or de facto relationship).
Based on MSD welfare benefit data and birth registration data. Note that where the parents separate and re-partner by the time of the child's birth, relationship information recorded on the birth certificate will be an imperfect indicator of whether the mother or father is a single parent.

Mother supported by benefit for more than 3 of last 5 years (m_mother_ben_gt_3_of_last5y) Mother recorded as having received main benefits for more than 3 of the 5 years prior to the child's birth. Includes time supported by benefit as a dependent child for younger mothers. Based on MSD welfare benefit data.

Mother served a sentence in the 5 years prior to child's birth (m_mother_any_sentence_last5y) Mother was recorded as having served a sentence in the 5 years prior to the child's birth. Based on Corrections data on sentences served. Note sentences include non-custodial sentences.

Maternal history of addiction service usage in 5 years prior to child's birth (m_mother_primhd_ad_last5y) Including only people with face-to-face contact. Includes publicly funded services only. PRIMHD was introduced in July 2008. Reporting of publicly funded services provided by NGOs has increased over time. Based on MoH PRIMHD data.

Maternal history of non-addiction mental health service usage in 5 years prior to child's birth (m_mother_primhd_mh_last5y) Including only people with face-to-face contact.

Includes publicly funded services only. PRIMHD was introduced in July 2008. Reporting of publicly funded services provided by NGOs has increased over time. Based on MoH PRIMHD data.

Mother prescribed any pharmaceuticals used solely to treat mood mental health disorders in 5 years prior to child's birth (m_mother_mood_ph_last5y) Disorders derived from MIMS New Ethicals and the British National Formulary (BNF). Note that this will not identify every person with a mood disorder and pharmaceuticals may be prescribed in a non-standard way to individuals without mood disorders. Based on MoH pharmaceuticals data.

Mother prescribed any pharmaceuticals used solely to treat substance use mental health disorders other than mood and anxiety disorders mental health disorders in 5 years prior to child's birth (m_mother_subs_ph_last5y) Disorders derived from MIMS New Ethicals and the British National Formulary (BNF). Note that this will not identify every person with a substance use mental health disorder and pharmaceuticals may be prescribed in a non-standard way to individuals without substance use mental health disorders. Based on MoH pharmaceuticals data.

Maternal history of receipt of Sickness or Invalids Benefit in 5 years prior to child's birth with an incapacity code that indicates mental health (m_mthr_SBIB_mh_dx_last5y) Based on MSD welfare benefit data.

Maternal history of receipt of Sickness or Invalids Benefit in 5 years prior to child's birth with an incapacity code that indicates substance abuse (m_mthr_SBIB_subsab_dx_last5y) Based on MSD welfare benefit data.

Mother had record of mental health or substance abuse issues in the 5 years prior to child's birth (m_mother_known_subs_mh_last5y) Maternal record of history of mental health or substance abuse issues in the 5 years prior to child's birth based on the following administrative data:
- Sickness or Invalids Benefit receipt with an incapacity code that indicates substance abuse or mental health disorder (based on MSD welfare benefit data),
- prescribed pharmaceuticals used solely to treat (i) mood mental health disorders or (ii) substance use mental health disorders other than mood and anxiety disorders mental health disorders (derived from MIMS New Ethicals and the British National Formulary) (based on MoH pharmaceuticals data), or
- use of face-to-face publicly funded community-based mental health services including either (i) a non-addiction mental health service, or (ii) an addiction service (based on MoH PRIMHD data).

Father recorded on birth registration (m_father_reg_on_birth_reg) Father or same sex partner is named on the birth registration. Based on birth registration data.

Father served a sentence in the last 5 years (if father registered) (m_father_any_sentence_last5y) Children for whom there is a birth registration and the father is registered on the birth registration and the father was recorded in Corrections data as having served a sentence in the 5 years prior to the child's birth. Based on Corrections data on sentences served. Sentences include non-custodial sentences.

Father on Sickness or Invalids Benefit in 5 years prior to child's birth with an incapacity code that indicates mental health (if father registered) (m_fthr_SBIB_mh_dx_last5) Based on MSD welfare benefit data.

Father on Sickness or Invalids Benefit in 5 years prior to child's birth with an incapacity code that indicates substance abuse (if father registered) (m_fthr_SBIB_subsab_dx_last5) Based on MSD welfare benefit data.

Father received an incapacity related benefit for mental health or substance abuse in the 5 years prior to child's birth (if father registered) (m_father_ben_subs_mh_last5y) Based on MSD welfare benefit data.
Father notified to CYF before age 18 (if father registered) (m_father_notif_b4_18) Notifications include care and protection notifications and Youth Justice referrals. Based on MSD CYF data. Note older CYF records are incomplete so this measure likely understates maternal CYF involvement, more so for older fathers.
Father in CYF placement before age 18 (if father registered) (m_father_placement_b4_18) Father had a care and protection or Youth Justice placement recorded before 18 years of age. Based on MSD CYF data. Note older CYF records are incomplete so this measure likely understates paternal placement history more so for older fathers.
Māori child (m_TR_eth_of_child_NZ_Maori) Based on total response data. Based on birth registration information where available and MAT information in remaining cases.
Pacific child (m_TR_eth_of_child_Pacific) Based on total response data. Based on birth registration information where available and MAT information in remaining cases.
Mother under 18 at child's birth (m_mother_under_18) Based on MAT data.
Mother under 20 at child's birth (m_mother_under_20) Based on MAT data.
Mother under 25 at child's birth (m_mother_under_25) Based on MAT data.
Mother smoked at time of delivery (o_mother_smokes) Flag indicating whether mother was identified as a current tobacco user during the delivery admission. Collected from diagnosis codes present on the delivery event record. Only available for women delivering in hospital. Based on MAT data. Note MAT Data Dictionary indicates this flag was only well reported from 2008/09 but no obvious discontinuity in the data at that time.
Need Indicator (count of risk factors) Based on a count of positive values for the following: (1) Born in NZDep 9 neighbourhood; (2) Born in NZDep 10 neighbourhood; (3) Father served a sentence in the last 5 years; (4) Father received an incapacity related benefit for mental health or substance abuse in the 5 years prior to child's birth; (5) Father notified to CYF before age 18 years of age; (6) Father had a CYF care and protection or CYF Youth Justice placement recorded before 18 years of age; (7) Father received an incapacity related benefit for mental health disorder in the 5 years prior to child's birth (8) Father received an incapacity-related benefit for substance abuse in the 5 years prior to child's birth; (9) High parenting demands indicated by benefit data indicating either multiple children aged under 2, multiple birth children, or >3 children in the family; (10) Mother served a sentence in the 5 years prior to child's birth; (11) Mother supported by benefit for more than 3 of the 5 years prior to child's birth; (12) Mother supported by benefit for more than 4 of the 5 years prior to child's birth; (13) Mother notified to CYF before age 18 years of age; (14) Mother had a CYF care and protection or CYF Youth Justice placement recorded before 18 years of age; (15) Mother had record of mental health or substance abuse issues in the 5 years prior to child's birth; (16) Mother received an incapacity-related welfare benefit for substance abuse in the 5 years prior to child's birth; (17) Mother received an incapacity-related welfare benefit for mental health disorder in the 5 years prior to child's birth; (18) Mother was prescribed pharmaceuticals used solely to treat mood mental health disorders in the 5 years prior to child's birth; (19) Mother was prescribed pharmaceuticals used solely to treat substance use mental health disorders other than mood and anxiety disorders; (20) Mother used a face-to-face publicly funded community-based non-addiction

mental health service in the 5 years prior to child's birth; (21) Mother used a face-to-face publicly funded community-based non-addiction mental health service in the 5 years prior to child's birth; (22) Mother single at child's birth; (23) Mother single at child's first inclusion in a welfare benefit; (24) Mother under 18 at child's birth; (25) Mother under 20 at child's birth; (26) Mother under 25 at child's birth; (27) Other children in respect of whom there were CYF Police family violence notifications or contact records in the last year; (28) Other children in respect of whom there were CYF notifications or CYF Police family violence contact records in the last 5 years; (29) Other children in respect of whom there were CYF placements in the last 5 years.

Outcome variables

Mother received addiction service (o_mother_primhd_ad_nexty, o_mother_primhd_ad_y2) Mother recorded as having community-based addiction service usage. Including only people with face-to-face contact. Includes publicly funded services only. Reporting of publicly funded services provided by NGOs has increased over time. Based on MoH PRIMHD data. First year outcome is service usage in first year of child's life. Second year outcome is service usage in second year of child's life. Note PRIMHD was introduced in July 2008. Data from the preceding MHINC collection was loaded into PRIMHD at that time. There are known data quality issues with MHINC data and reporting practices changed between MHINC and PRIMHD periods. These changes may result in slight changes in totals and rates.

Mother received mental health service (o_mother_primhd_mh_nexty, o_mother_primhd_mh_y2) Mother recorded as having community-based non-addiction mental health service in year post the child's birth. Including only people with face-to-face contact. Includes publicly funded services only. Reporting of publicly funded services provided by NGOs has increased over time. Based on MoH PRIMHD data. First year outcome is service usage in first year of child's life. Second year outcome is service usage in second year of child's life. Note PRIMHD was introduced in July 2008. Data from the preceding MHINC collection was loaded into PRIMHD at that time. There are known data quality issues with MHINC data and reporting practices changed between MHINC and PRIMHD periods. These changes may result in slight changes in totals and rates.

Fully immunised at 1+ milestone age (o_imm_excl_pcv_1plus_compl_by1, o_imm_excl_pcv_1plus_compl_by2) First year outcome is up to date with scheduled immunisations at one or more milestone age up to 12 months. Second year outcome is up to date with scheduled immunisations at one or more milestone age up to 24 months. Excluding pneumococcal conjugate vaccine. Milestone ages are at 6, 8, 12, 18 and 24 months. Scheduled immunisations are due at 6 weeks, 3 months, 5 months and 15 months. Based on MoH National Immunisation Register data.

Fully immunised at every milestone age (o_imm_excl_pcv_fully_compl_by1, o_imm_excl_pcv_fully_compl_by2) First year outcome is up to date with scheduled immunisations at every milestone age up to 12 months. Second year outcome is up to date with scheduled immunisations at every milestone age up to 24 months.   Excluding pneumococcal conjugate vaccine. Milestone ages are at 6, 8, 12, 18 and 24 months. Scheduled immunisations are due at 6 weeks, 3 months, 5 months and 15 months. Based on MoH National Immunisation Register data.

Enrolment with Primary Health Organisation (o_PHO_enrolled_at_1, o_PHO_enrolled_at_2) Child enrolled with a Primary Health Organisation at their birthday. Based on MoH Primary Health Organisation Enrolment Collection. First year outcome is as at first

birthday. Second year outcome is as at second birthday.

Participation in Before School Check (o_participated_in_B4SC) Child born in 2009 and participated in a Well Child/Tamariki Ora Before School Check (B4SC). Based on MoH B4SC data. Note: The B4SC is offered to all families with four-year-old children. Most children are assessed at age four, but if they miss out they are assessed at age five at school.

Attends Early Childhood Education (o_B4SC_attendpreschool) Child participated in a B4SC and was coded by MoH as "probably" attending pre-school based on response to the question "Which preschool, if any, does your child attend?" on the Child Health Questionnaire. Based on MoH B4SC data. Note: The B4SC is offered to all families with four-year-old children. Most children are assessed at age four, but if they miss out they are assessed at age five at school.

Hospitalisation for long bone fracture (o_hosp_lbf_injury_by1, o_hosp_lbf_injury_y2) Child hospitalised for long bone fracture injury. ICD-10-AM codes S42.2, S42.3, S42.4, S42.7, 42.8, S52, S72, S82, T10, T12.Note: Excludes short-stay Emergency Department-only events. Publicly funded hospital discharges only. Based on MoH NMDS data. First year outcome is hospital admission with discharge date in first year of child's life. Second year outcome is hospital admission with discharge date in second year of child's life.

Hospitalisation for intracranial injury (o_hosp_ic_injury_by1) Hospitalisation for intracranial injury in with a discharge date within 1 year of birth. ICD-10-AM code S06. Note: Excludes short-stay Emergency Department-only events. Publicly funded hospital discharges only. Based on MoH NMDS data.

Hospitalisation for maltreatment-related injury (o_hosp_mal_injury_by1, o_hosp_mal_injury_y2) Any hospital admission of child for maltreatment-related injury. Includes events with at least one ICD-10-AM code S00 - T98 and either:
- Maltreatment-syndrome: ICD-10-AM codes T74, Y06, Y07, or T73
- Assault: ICD-10-AM codes X85 - Y09
- Undetermined cause: ICD-10-AM codes Y10 -Y34, Z04.0, Z04.5, Z04.8
- Adverse social circumstances: ICD-10-AM codes Z60 - Z63, Z72, Z74, Z76.1, Z76.2, Z81, Z86.5, Z91.6, Z91.8

First year outcome is hospital admission with discharge date in first year of child's life. Second year outcome is hospital admission with discharge date in second year of child's life. Note: Excludes short-stay Emergency Department-only events. Publicly funded hospital discharges only. Based on MoH NMDS data.

Any notification (o_notif_any_by1, o_notif_any_y2) Child was the subject of a report of concern to CYF. Includes all notifications by all notifier types. Excludes CYF Police Family Violence contact records. Based on MSD CYF data. First year outcome is notification recorded in first year of child's life. Second year outcome is notification recorded in second year of child's life.

Findings of emotional abuse (o_fdgs_emot_abuse_by1, o_fdgs_emot_abuse_y2) Child recorded as having CYF substantiated findings of emotional abuse. Based on MSD CYF data. First year outcome is findings recorded in first year of child's life. Second year outcome is findings recorded in second year of child's life.

Findings of physical abuse (o_fdgs_phys_abuse_by1, o_fdgs_phys_abuse_y2) Child recorded as having CYF substantiated findings of physical abuse. Based on MSD CYF data. First year outcome is findings recorded in first year of child's life. Second year outcome is findings recorded in second year of child's life.

Findings of neglect (o_fdgs_neglect_by1, o_fdgs_neglect_y2) Child recorded as having

CYF substantiated findings of neglect. Based on MSD CYF data. First year outcome is findings recorded in first year of child's life. Second year outcome is findings recorded in second year of child's life.

Placement commenced (o_placement_by1, o_placement_y2) Child recorded as commencing a CYF placement. Based on MSD CYF data. First year outcome is placement recorded as starting in first year of child's life. Second year outcome is placement recorded as starting in second year of child's life. Note when a child or young person is placed in the custody of the Chief Executive of the Ministry of Social Development, a placement record must be created to record that child or young person's primary living arrangement. In some cases children remain at home. In a small number of cases, placements are recorded when the child is not in the care of the Chief Executive, or the child is care of the Chief Executive and no placement is recorded.

Post-neonatal mortality (o_inf_mort_post_neonatal, o_mortality_y2) First year outcome is death of an infant aged 29 days to 1 year. Based on MoH Mortality Collection. Second outcome is death of a child aged 1.

Post neonatal SUDI (o_infant_mortality_sudi) Sudden unexpected death of an infant aged 29 days to 1 year where the ICD-10-AM main underlying cause of death was: SIDS (R95); SUDI: Unspecified (R96, R98, R99); SUDI: Suffocation/ strangulation in bed (W75); SUDI: Inhalation of gastric contents/food (W78, W79). Based on MoH Mortality Collection data.

Post neonatal injury death (o_infant_mortality_postneo_inj, o_mortality_inj_y2) First year outcome is death of an infant aged 29 days to 1 year where the cause was injury or poisoning - ICD-10-AM main underlying cause of death V01-Y36 (includes intentional and unintentional injury deaths). Second year outcome is death of a child aged 1 where the cause was injury or poisoning. Based on MoH Mortality Collection data.

Appendix D. SUDI Prevention Efforts as a Competing Explanation

Rates of all cause post neonatal infant deaths were gradually trending downwards over the 2004-2011 period during which our study cohorts were born, and fell comparatively steeply in 2012, the last year in which study cohort members passed through infancy. The decline in all cause post neonatal deaths was partly driven by a reduction in SUDI which was most marked for Māori infants (New Zealand Mortality Review Group, 2013).

An important question is whether other changes occurred during in the study period with the potential to disproportionately reduce infant mortality in phase-in TLAs. Advice on this was sought from programme experts, and a number of robustness checks were implemented to establish whether these could provide alternative explanations for the study's estimated FS impacts.[55]

One concern was that reduced infant mortality might reflect the impact of SUDI prevention initiatives which occurred in some District Health Boards (DHBs) and which coincided with the period of our study, rather than the impact of FS. SUDI prevention initiatives included the following: (i) from 2006 safe shared sleeping was promoted through provision of wahakura (flax bassinets) targeted to high-risk families in a number of DHBs[56] (these efforts were on a relatively small scale, with the cost of producing wahakura a limiting factor) (Abel and Tipene-Leach, 2013); (ii) in 2010 the Ministry of Health directed 8 DHBs to work on SUDI prevention as part of a Māori Health Strategy[57] - 3 DHBs were particularly active in their response[58]; and (iii) in 2011, Change for our Children distributed 1,000 Pēpi-pods (low cost basinets made from plastic) in the Christchurch area to families with infants affected by the February 2011 earthquake, and in 2012 (the last year of infancy for study cohorts) began distribution on a larger scale to organisations nationwide (Cowan, 2015).[59] As a result of these various efforts, tailoring of SUDI prevention messages to Māori and high-risk families was improved, and distribution of Pēpi-pods and wahakura appear to have allowed culturally valued shared sleeping behaviours to continue in a safer way (Best Practice Journal, 2013; Cowan 2015; Abel and Tipene-Leach, 2013).

A number of robustness checks were undertaken to assess whether SUDI prevention efforts could explain the study results. Firstly, we restricted our FE analysis only to TLAs within the

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[55]Changes to the baseline models were also made following this advice. These included more extensive controls for age of mother and rural-urban status.

[56]Tairawhiti, Northland, all the Auckland DHBs, Waikato and Hawkes Bay.

[57]Counties Manukau, Northland, Waikato, Lakes, Hawke's Bay, MidCentral, Hutt Valley, and Whanganui DHBs were required to outline to the Ministry (i) how DHB health services have safe sleep policies, train staff in SUDI prevention, and ensure that safe sleep practice is implemented in healthcare settings; (ii) how health services provide accessible and appropriate antenatal and early parenting education to Māori women and whānau; and (iii) any activities related to ensuring infants have access to safe sleep spaces.

[58]Counties Manukau, Waikato and Hawkes Bay (Personal Communication, Ministry of Health).

[59]Uptake as a percentage of Māori births was highest in the Waikato, Tairawhiti and Hawkes Bay DHBs (Personal correspondence, Stephanie Cowan, Change for our Children).

8 DHBs that were directed to undertake SUDI prevention activities in 2010. For this restricted sample, FS being available in the TLA continued to have no statistically significant impact on post neonatal SUDI (-0.002, p=0.17), and continued to have a negative and statistically significant impact on all cause post neonatal infant mortality (p<0.1). Additionally, we tested robustness of the FE results to the exclusion of the 2010 and 2011 cohorts in order to minimise overlap with the period following the 2010 directive and the beginning of national Pēpi-pod distribution. The estimated impact on all cause post neonatal infant mortality was robust to dropping the cohorts born in 2010 and 2011 and the impact on post neonatal SUDI remained insignificant (-0.001, p=0.17). Finally, we ran a PSM excluding the Waikato DHB (one of the most active DHBs in SUDI prevention). Mortality results were robust.

In practice, FS and the post 2010 SUDI prevention efforts should perhaps not be viewed as competing explanations, but rather as potentially working in combination. In 2015, 9 out of the 10 providers in phase-in TLAs in the DHBs directed to work towards SUDI prevention responded to a short survey about SUDI prevention activities in their areas. All but one responded that they helped distribute Pēpi-pods or wahakura to high-risk families. And all but one reported that they had received training in safe sleep practices from the DHB or another organisation since 2011. FS providers offer a point of connection with high-risk families, and a means to disseminate public health messages and resources to families that would otherwise be hard to reach.

To test whether a particular TLA was driving the FE results, we re-estimated the model (on the benefit sample) dropping one TLA at a time. The statistical significance of the estimated impact of FS on all cause post neonatal infant mortality remained in each case.

References

Best Practice Journal (2013). Upfront - Sudden unexpected death in infancy: Where are we now? *Best Practice Journal*, 56, 3-7.

Cowan, S. (2015). *Their First Five Hundred Sleeps: Pēpi-Pod Report 2012-2014 Describing three years of distribution and use of portable sleep spaces for babies at increased risk of sudden infant death.* Christchurch: Change for our Children Limited.

Child and Youth Mortality Review Committee (2009). *Fifth report to the Minister of Health: Reporting mortality 2002-2008*. Wellington: Child and Youth Mortality Review Committee.

New Zealand Mortality Review Group (2013). *9th data report 2008-2012*. Wellington: Child and Youth Mortality Review Committee.

Appendix E. Sub-group Results

Appendix Table E0 Panel A: Means of Outcomes in the Control Group [95%CI] (Individual PSM)

	Outcomes in the First Year of Life				Outcomes in the Second Year of Life			
	Māori		Pacific		Māori		Pacific	
Mother Received Addiction Service	0.033	[0.025, 0.042]	0.013	[0.01, 0.019]	0.034	[0.026, 0.043]	0.024	[0.017, 0.032]
(With No Addiction Service in First Year)	N/A	N/A	N/A	N/A	0.019	[0.013, 0.026]	0.018	[0.010, 0.026]
Mother Received Mental Health Service	0.065	[0.054, 0.077]	0.032	[0.023, 0.041]	0.043	[0.034, 0.053]	0.022	[0.016, 0.030]
(With No Mental Health Service in First Year)	N/A	N/A	N/A	N/A	0.023	[0.016, 0.030]	0.010	[0.006, 0.019]
Enrolled with PHO	0.940	[0.928, 0.951]	0.971	[0.962, 0.980]	0.965	[0.956, 0.973]	0.986	[0.980, 0.992]
Fully Immunized at 1+ Milestone Age	0.797	[0.778, 0.816]	0.853	[0.836, 0.871]	0.908	[0.894, 0.922]	0.939	[0.927, 0.951]
Fully Immunized at Every Milestone Age	0.487	[0.464, 0.511]	0.627	[0.603, 0.651]	0.425	[0.402, 0.448]	0.565	[0.541, 0.590]
Hospitalized for Long Bone Fracture	0.001	[0.000, 0.003]	0.004	[0.00, 0.007]	0.002	[0.00, 0.004]	0.001	[0.00, 0.003]
Hospitalized for Intracranial Injury	0.005	[0.001, 0.008]	0.001	[0.00, 0.002]	0.002	[0.00, 0.004]	N/A	N/A
Hospitalized for Maltreatment Injury	0.005	[0.002, 0.008]	0.003	[0.000, 0.006]	0.002	[0.00, 0.004]	♦	♦
Any Notification	0.280	[0.259, 0.301]	0.160	[0.142, 0.178]	0.232	[0.208, 0.256]	0.197	[0.017, 0.221]
(With No Notification in First Year)	N/A	N/A	N/A	N/A	0.106	[0.089, 0.124]	0.085	[0.068, 0.010]
Findings of Emotional Abuse	0.054	[0.044, 0.065]	0.050	[0.039, 0.061]	0.068	[0.053, 0.082]	0.051	[0.038, 0.064]
(With No Notification in First Year)	N/A	N/A	N/A	N/A	0.023	[0.014, 0.031]	0.016	[0.009, 0.024]
Findings of Physical Abuse	0.007	[0.003, 0.011]	0.002	[0.000, 0.004]	0.005	[0.001, 0.009]	0.000	[0.000, 0.000]
(With No Notification in First Year)	N/A	N/A	N/A	N/A	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]
Findings of Neglect	0.030	[0.022, 0.038]	0.012	[0.007, 0.018]	0.031	[0.021, 0.041]	0.022	[0.013, 0.031]
(With No Notification in First Year)	N/A	N/A	N/A	N/A	0.008	[0.003, 0.013]	0.001	[-0.001, 0.003]
Placement Commenced	0.015	[0.009, 0.021]	0.007	[0.003, 0.011]	0.018	[0.011, 0.026]	0.000	[0.000, 0.000]
(With No Notification in First Year)	N/A	N/A	N/A	N/A	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]
Post Neonatal Mortality	0.006	[0.002, 0.010]	0.001	[-0.001, 0.002]	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]
Post Neonatal SUDI	0.006	[0.003, 0.010]	0.000	[0.000, 0.000]	N/A	N/A	N/A	N/A
Post Neonatal Injury Death	0.0020	[-0.000, 0.004]	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]	♦	♦

♦ There were no second year events in the Pacific sub-sample.

Appendix Table E0 Panel B: Means of Outcomes in the Control Group Over Time, Benefit Population (Community, FE, First Year Outcomes Only), Māori

	Mean			
	Overall	Q3 2004-Q2 2005	Q3 2005-Q2 2007	Q3 2007-Q4 2011
Mother Received Addiction Service	0.022	0.009	0.021	0.025
Mother Received Mental Health Service	0.053	0.039	0.043	0.060
Enrolled with PHO	0.958	0.949	0.948	0.964
Hospitalized for Long Bone Fracture	0.0023	0.0004	0.0052	0.0015
Hospitalized for Intracranial Injury	0.0012	0.0011	0.0019	0.0010
Hospitalized for Maltreatment Injury	0.0007	0.0012	0.0004	0.0008
Any Notification	0.211	0.141	0.181	0.239
Findings of Emotional Abuse	0.037	0.016	0.033	0.044
Findings of Physical Abuse	0.006	0.005	0.006	0.006
Findings of Neglect	0.026	0.025	0.026	0.026
Placement Commenced	0.014	0.014	0.018	0.012
Post Neonatal Infant Mortality	0.0043	0.0019	0.0049	0.0046
Post Neonatal SUDI	0.0024	0.0009	0.0036	0.0022
Post Neonatal Infant Injury Death	0.0015	0.0003	0.0012	0.0019

	Mean			
	Overall	Q3 2004-Q2 2005	Q3 2005-Q2 2007	Q3 2007-Q4 2011
Mother Received Addiction Service	0.010	0.004	0.007	0.012
Mother Received Mental Health Service	0.039	0.018	0.035	0.045
Enrolled with PHO	0.959	0.928	0.954	0.968
Hospitalized for Long Bone Fracture	0.0047	0.0011	0.0061	0.0049
Hospitalized for Intracranial Injury	0.0012	0.0001	0.0035	0.0005
Hospitalized for Maltreatment Injury	0.0005	0.0021	0.0007	0.0000
Any Notification	0.193	0.129	0.196	0.205
Findings of Emotional Abuse	0.039	0.010	0.044	0.043
Findings of Physical Abuse	0.009	0.005	0.016	0.007
Findings of Neglect	0.023	0.023	0.037	0.017
Placement Commenced	0.011	0.006	0.019	0.009
Post Neonatal Infant Mortality	0.0015	0.0012	0.0020	0.0014
Post Neonatal SUDI	0.0007	0.0001	0.0003	0.0011
Post Neonatal Infant Injury Death	0.0003	0.0000	0.0000	0.0005

	Coefficient estimate (with 95% CI and p-value) on Family Start indicator			
	Outcomes in the First Year		Outcomes in the Second Year	
	Māori	Pacific	Māori	Pacific
Mother Received Addiction Service	0.0268**	0.0301	0.0273**	0.0092*
	[0.002, 0.051]	[-0.007, 0.067]	[0.002, 0.053]	[-0.001, 0.019]
	p=0.034	p=0.110	p=0.036	p=0.070
(With No Addiction Service in First Year)			0.020*	0.0037
	N/A	N/A	[-0.003, 0.044]	[-0.005, 0.012]
			p=0.089	p=0.378
Mother Received Mental Health Service	0.0898***	0.0409***	0.0338	0.035***
	[0.040, 0.139]	[0.021, 0.060]	[-0.008, 0.076]	[0.017, 0.053]
	p=0.000	p=0.000	p=0.109	p=0.000
(With No Mental Health Service in First Year)			0.013	0.0115*
	N/A	N/A	[-0.009, 0.034]	[-0.002, 0.025]
			p=0.263	p=0.088
Enrolled with Primary Health Organization	-0.0313***	-0.0315	0.0129***	0.0022
	[-0.054, -0.008]	[-0.083, 0.020]	[0.004, 0.022]	[-0.024, 0.028]
	p=0.007	p=0.228	p=0.007	p=0.866
Fully Immunized at 1+ Milestone Age	0.0683***	0.0474***	0.0374***	0.0274***
	[0.043, 0.094]	[0.023, 0.072]	[0.017, 0.058]	[0.008, 0.047]
	p=0.000	p=0.000	p=0.000	p=0.005
Fully Immunized at Every Milestone Age	0.0762**	0.0396	0.0752***	0.0468
	[0.018, 0.135]	[-0.036, 0.115]	[0.019, 0.131]	[-0.026, 0.120]
	p=0.011	p=0.305	p=0.009	p=0.208

Notes: These estimates are from regressions using propensity score matching utilizing nearest neighbour matching on propensity score, with exact match on ethnic group, rurality, age of mother, child supported by benefit before 13 weeks, whether NZDep 9/10 and year of birth (for Pacific, matching excludes year of birth). It compares treated individuals in phased-in TLAS with matched individuals in never-treated TLAs. Results can all be interpreted as the average change in the probability of the outcome occurring as a result of treatment (eg. a 6.83 percentage point increase in the proportion of Māori children fully immunised at 1+ milestone by age 1, 95% CI 4.3 to 9.4 percentage points). Parameter estimates statistically different than 0 at 99% (***), 95% (**), and 90% (*) confidence.

Appendix Table E2: Impact of Family Start on Health Service Engagement for Benefit Population (Community FE, First Year Outcomes Only)

	Coefficient estimate (with 95% CI and p-value) on Family Start indicator	
	Māori	Pacific
Mother Received Addiction Service	-0.0128	0.0055
	[-0.03, 0.004]	[-0.01, 0.021]
	p=0.150	p=0.474
Mother Received Mental Health Service	0.0037	0.0051
	[-0.018, 0.025]	[-0.016, 0.027]
	p=0.735	p=0.637
Enrolled with Primary Health Organization	0.0043	-0.0240
	[-0.02, 0.028]	[-0.057, 0.009]
	p=0.731	p=0.165

Notes: These estimates are from fixed effects regressions with robust standard errors clustered at the TLA level. Regressions control for quarter indicators as well as an indicator for whether the mother was under 18. Outcomes are divided by the total count in the community and thus can be interpreted as changes in the proportion in a community experiencing that outcome (eg. a 4.3 percentage point increase in the proportion of Māori children enrolled with a PHO at age 1, 95% CI -2.0 to 2.8 percentage points and not statistically significant). Parameter estimates statistically different than 0 at 99% (***), 95% (**), and 90% (*) confidence.

Appendix Table E3: Impact of Family Start on Maltreatment Marker Injuries and CYF Contact (Individual PSM)

	Coefficient estimate (with 95% CI and p-value) on Family Start indicator					
	Outcomes in the First Year		Outcomes in the Second Year		Outcomes in the Second Year (With No Notification in First Year)	
	Māori	Pacific	Māori	Pacific	Māori	Pacific
Hospitalised for Long Bone Fracture	0.0030	0.0028	-0.0018***	-0.0008	N/A	N/A
	[-0.007, 0.013]	[-0.002, 0.008]	[-0.003,	[-0.002, 0.001]		
	p=0.536	p=0.285	p=0.004	p=0.290		
Hospitalised for Intracranial Injury	0.0006	-0.0007				
	[-0.002, 0.003]	[-0.002, 0.001]	N/A	N/A	N/A	N/A
	p=0.651	p=0.426				
Hospitalised for Maltreatment Related Injury	0.0026	-0.0009	0.0011			
	[-0.001, 0.007]	[-0.003, 0.002]	[-0.003, 0.005]	♦	N/A	N/A
	p=0.215	p=0.476	p=0.56			
Any Notification	0.1787***	0.1397***	0.1231***	0.0902***	0.0065	0.0128
	[0.123, 0.234]	[0.067, 0.212]	[0.061, 0.185]	[0.032, 0.149]	[-0.020, 0.033]	[-0.017, 0.042]
	p=0.000	p=0.000	p=0.000	p=0.003	p=0.629	p=0.393
Findings of Emotional Abuse	0.0787***	0.0525	0.0577***	0.0697***	0.0048	0.0185*
	[0.048, 0.109]	[-0.012, 0.117]	[0.028, 0.088]	[0.024, 0.115]	[-0.008, 0.018]	[-0.004, 0.004]
	p=0.000	p=0.109	p=0.000	p=0.003	p=0.458	p=0.100
Findings of Physical Abuse	0.0038*	0.0032**	0.0021	-0.0011	0.0007	-0.0003
	[-0.001, 0.008]	[0.000, 0.006]	[-0.001, 0.005]	[-0.002, 0.001]	[-0.001, 0.002]	[-0.001, 0.001]
	p=0.092	p=0.046	p=0.192	p=0.228	p=0.448	p=0.601
Findings of Neglect	0.0246***	0.0175***	0.0034	0.0202***	-0.0009	0.0113***
	[0.012, 0.038]	[0.005, 0.031]	[-0.018, 0.025]	[0.009, 0.032]	[-0.009, 0.007]	[0.003, 0.020]
	p=0.000	p=0.008	p=0.761	p=0.000	p=0.825	p=0.009
Placement Commenced	0.0063*	0.0002	0.0111**	0.0138***	0.0023	0.007**
	[-0.001, 0.014]	[-0.008, 0.012	[0.000, 0.022]	[0.004, 0.024]	[-0.005, 0.010]	[-0.00, 0.014]
	p=0.089	p=0.689	p=0.044	p=0.006	p=0.738	p=0.057

Notes to Appendix Table E3: Impact of Family Start on Maltreatment Marker Injuries and CYF Contact (Individual PSM)

These estimates are from regressions using propensity score matching utilizing nearest neighbour matching on propensity score, with exact match on ethnic group, rurality, age of mother, child supported by benefit before 13 weeks, whether NZDep 9 /10 and year of birth (for Pacific year 1 estimates, matching excludes year of birth; for year 2 estimates other than hospitalisation measures for both groups, matching is on propensity score, with exact match on ethnic group, rurality, age of mother and whether NZDep 9 /10). It compares treated individuals in phased-in TLAS with matched individuals in never-treated TLAs. Results can all be interpreted as the average change in the probability of the outcome occurring as a result of treatment (eg. a 1.13 percentage point increase in the proportion of Pacific children with findings of neglect in their second year having had no notification in their first year, 95% CI 0.3 to 2.0 percentage points). Parameter estimates statistically different than 0 at 99% (***), 95% (**), and 90% (*) confidence.

♦ There were no second year maltreatment-related injury hospitalisations in the Pacific sub-sample.

Appendix Table E4: Impact of Family Start on Maltreatment Marker Injuries and CYF Contact for Benefit Population (Community FE, First Year Outcomes Only)

	Coefficient estimate (with 95% CI and p-value) on Family Start indicator	
	Māori	Pacific
Hospitalized for Long Bone Fracture	-0.0006	-0.0025
	[-0.003, 0.001]	[-0.008, 0.004]
	p=0.552	p=0.424
Hospitalized for Intracranial Injury	-0.0013	-0.0074
	[-0.003, 0.001]	[-0.017, 0.003]
	p=0.209	p=0.153
Hospitalized for Maltreatment Related Injury	0.0000	-0.0073
	[-0.004, 0.004]	[-0.018, 0.004]
	p=0.985	p=0.201
Any Notification	0.0113	-0.0024
	[-0.05, 0.073]	[-0.08, 0.075]
	p=0.723	p=0.955
Findings of Emotional Abuse	0.0197***	0.0094
	[0.006, 0.034]	[-0.015, 0.034]
	p=0.008	p=0.456
Findings of Physical Abuse	-0.0050	-0.0060
	[-0.013, 0.003]	[-0.019, 0.007]
	p=0.210	p=0.379
Findings of Neglect	0.0043	-0.0085
	[-0.011, 0.020]	[-0.045, 0.028]
	p=0.594	p=0.646
Placement Commenced	-0.0004	-0.0049
	[-0.011, 0.010]	[-0.018, 0.008]
	p=0.940	p=0.469

Notes: These estimates are from fixed effects regressions with robust standard errors clustered at the TLA level. Regressions control for quarter indicators as well as an indicator for whether the mother was under 18. Outcomes are divided by the total count in the community and thus can be interpreted as changes in the proportion in a community experiencing that outcome (eg. a 1.97 percentage point increase in the proportion of Māori children with findings of emotional abuse by age 1, 95% CI 0.6 to 3.4 percentage points). Parameter estimates statistically different than 0 at 99% (***), 95% (**), and 90% (*) confidence.

Appendix Table E5: Impact of Family Start on Mortality (Individual PSM)

	Coefficient estimate (with 95% CI and p-value) on Family Start indicator			
	Outcomes in the First Year		Outcomes in the Second Year	
	Māori	Pacific	Māori	Pacific
Post Neonatal Infant Mortality	-0.0031***	-0.0023***	-0.0006*	-0.0008
	[-0.0050, -0.0011]	[-0.0039, -0.0007]	[-0.0012, 0.0000]	[-0.0018, 0.0003]
	p=0.002	p=0.005	p=0.071	p=0.149
Post Neonatal SUDI	-0.0029***	-0.0014***	N/A	N/A
	[-0.0043, -0.0015]	[-0.0028, -0.0001]		
	p=0.000	p=0.007		
Post Neonatal Infant Injury Death	-0.0014***	-0.0011**	-0.0003*	
	[-0.0022, -0.0006]	[-0.0023, 0.0002]	[-0.0007, -0.0000]	♦
	p=0.000	p=0.014	p=0.083	

Notes: These estimates are from regressions using propensity score matching utilizing nearest neighbour matching on propensity score, with exact match on ethnic group, rurality, age of mother, child supported by benefit before 13 weeks, whether NZDep 9 /10 and year of birth (for Pacific year 1 estimates, matching excludes year of birth; for year 2 estimates for both groups, matching is on propensity score, with exact match on ethnic group, rurality, age of mother and whether NZDep 9 /10). It compares treated individuals in phased-in TLAS with matched individuals in never-treated TLAs. Results can all be interpreted as the average change in the probability of the outcome occurring as a result of treatment (eg. a 0.29 percentage point or 2.9 per 1000 reduction in the proportion of children who died as a result of SUDI, 95% CI 1.5 to 4.3 per 1000 reduction). Parameter estimates statistically different than 0 at 99% (***), 95% (**), and 90% (*) confidence.

♦ There were no second year injury deaths in the Pacific sub-sample.

Appendix Table E6: Impact of Family Start on Mortality for Benefit Population (Community FE, First Year Outcomes Only)

	Coefficient estimate (with 95% CI and p-value) on Family Start indicator	
	Māori	Pacific
Post Neonatal Infant Mortality	-0.0049**	0.0013
	[-0.009, -0.001]	[-0.001, 0.004]
	p=0.026	p=0.312
Post Neonatal SUDI	-0.0015	0.0000
	[-0.005, 0.002]	[-0.001, 0.001]
	p=0.426	p=0.977
Post Neonatal Infant Injury Death	-0.0017	0.0000
	[-0.004, 0.001]	[-0.001, 0.001]
	p=0.146	p=0.997

Notes: These estimates are from fixed effects regressions with robust standard errors clustered at the TLA level. Regressions control for quarter indicators as well as an indicator for whether the mother was under 18. Outcomes are divided by the total count in the community and thus can be interpreted as changes in the proportion in a community experiencing that outcome (eg. an 0.49 percentage point or 4.9 per 1000 reduction in post neonatal infant mortality for Māori children, 95% CI 1 per 1000 to 9 per thousand). Parameter estimates statistically different than 0 at 99% (***), 95% (**), and 90% (*) confidence.

Appendix Table E7: Summary of Effects Sizes, Cohen's *d* (Individual, PSM)

	Outcomes in the First Year of Life		Outcomes in the Second Year of Life	
	Māori	Pacific	Māori	Pacific
	Effect (d)	Effect (d)	Effect (d)	Effect (d)
Mother Received Addiction Service	**0.07**	0.06	**0.07**	0.06
(With No Addiction Service in First Year)	N/A	N/A	**0.06**	0.03
Mother Received Mental Health Service	**0.12**	**0.15**	0.05	**0.14**
(With No Mental Health Service in First Year)	N/A	N/A	0.04	**0.06**
Enrolled with PHO	**0.09**	0.04	**0.09**	0.01
Fully Immunized at 1+ Milestone Age	**0.18**	**0.13**	**0.12**	**0.10**
Fully Immunized at Every Milestone Age	**0.09**	0.04	**0.09**	0.05
Hospitalized for Long Bone Fracture	0.02	0.04	0.10	0.04
Hospitalized for Intracranial Injury	0.02	0.03	N/A	N/A
Hospitalized for Maltreatment Injury	0.04	0.03	0.10	♦
Any Notification	**0.21**	**0.13**	**0.13**	**0.11**
(With No Notification in First Year)			0.02	0.03
Findings of Emotional Abuse	**0.17**	0.06	**0.13**	**0.11**
(With No Notification in First Year)			0.02	**0.06**
Findings of Physical Abuse	**0.06**	**0.07**	0.04	0.04
(With No Notification in First Year)			0.00	0.02
Findings of Neglect	**0.13**	**0.09**	0.01	**0.12**
(With No Notification in First Year)			0.02	**0.09**
Placement Commenced	**0.06**	0.01	**0.07**	**0.10**
(With No Notification in First Year)			0.00	**0.07**
Post Neonatal Mortality	**0.10**	**0.10**	**0.06**	0.05
Post Neonatal SUDI	**0.14**	**0.07**	N/A	N/A
Post Neonatal Injury Death	**0.12**	**0.06**	**0.06**	♦

Notes: Bolded values indicate effects where parameter estimates from the PSM are statistically different to 0 at >90% confidence.

♦ There were no second year events in the Pacific sub-sample.