

Short- and Longer-Term Impacts of the Healthy Families, Healthy Babies (HFHB) Postnatal Home Visiting Program on Child Health and Developmental Outcomes in New Brunswick



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Project Title

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Executive Summary

Early childhood development is a fundamental social determinant of health. Home visiting is a public health strategy to mitigate negative impacts from poverty and early childhood adversity, typically offered to families at high risk of poorer outcomes. Families are enrolled prenatally or postnatally and followed through pregnancy and the first years of the child's life.

Home visiting programs are shown to have benefits for both program participants and service providers; however, their longer-term impacts have not been properly evaluated among Canadian populations. Each Canadian province and territory offers a home visiting program, with several currently undergoing program review. More research is needed to inform these efforts.

The overall goal of this study is to evaluate the short- and longer-term impacts of participation in targeted postnatal home visiting services on breastfeeding behaviour and child development, and results will inform a review of the Healthy Families, Healthy Babies (HFHB) targeted postnatal home visiting program in New Brunswick.

A matched retrospective cohort study of all live births in New Brunswick, Canada, between April 1, 2012, and March 31, 2014, among families parenting for the first-time was developed using population-based administrative data accessible at the New Brunswick Institute for Research, Data and Training (NB-IRDT). Several linkable administrative data sets were used to define the study cohort, HFHB postnatal program participation, breastfeeding duration, and child developmental outcomes in toddlers and preschoolers, as well as a number of confounding variables.

A propensity score matching methodology was used to select a group of families that did not participate who were similar to those who participated. Multivariable regression models were used to provide statistical estimates of the differences in outcomes between groups while accounting for relevant confounding variables. A birth cohort of 6096 families parenting for the first time was established and followed longitudinally from birth to school age; 1211 participated in the postnatal home visiting program, and 1366 non-participating families were matched to participants.

Highlight of Findings

Results show that postnatal program participation has a positive impact on duration of breastfeeding but no impact on child development.

- Postnatal participants were found to breastfeed, on average, 33 days more than non-participants (95% CI: +32 to +35 days) and were 2.25 times more likely (95% CI: 1.55 to 3.26) to be breastfeeding at 18 months.

- Unexpectedly, postnatal participants were also 1.59 times more likely (95% CI: 1.18 to 2.14) to be breastfeeding at 18 months when compared to the average family (unadjusted estimates).
- When considering child development, participants were as likely to have a developmental concern identified (OR: 1.30; 95% CI: 0.81 to 2.08) at 18 months or to have significant difficulty identified prior to entry into kindergarten (OR: 1.09; 95% CI: 0.89 to 1.33).

This is among the first Canadian studies to evaluate the impacts of home visiting on breastfeeding behaviours and child development up to five years of age. The results of this research study are consistent with those found in the previous literature, most of which is focused on the US. While this research represents an important contribution to the scientific literature, more research is still needed to inform program planning in Canada.

Introduction

1.1 Background

Early life experiences are known to have lifelong impacts on biological, psychological, and social aspects of health (Raphael et al., 2020). Material and social deprivation during childhood can lead to poorer coping skills, health outcomes, and overall physical and mental wellbeing (Folger et al., 2017). Thus, supporting disadvantaged families during this important stage of life has implications for both maternal and child health (Lassi et al., 2013). Canadian women with greater socioeconomic disadvantage are less likely to report good or excellent health and more likely to experience postpartum depression (Landy et al., 2008). They are also found to be more likely to accept a universally offered home visit from a public health nurse and to continue public health nursing services four weeks postpartum (Landy et al., 2008).

Perinatal home visiting is a public health strategy used to mitigate negative impacts from poverty and early childhood adversity, typically serving younger, single parent families with low levels of education and poor health behaviours (e.g., smoking and no prenatal care). Families can be enrolled prenatally or postnatally and followed by public health professionals through pregnancy and early childhood, though the model and specific components of home visiting programs can vary widely. While eligibility for home visiting programs tends to be targeted to ensure the support of those most vulnerable, arguments have been made for universal home visiting programs to meet the needs of a larger proportion of the population (Aston et al., 2014).

A policy statement by the American Academy of Pediatrics highlights home visiting as a valuable policy tool to mitigate the harms from social determinants of health related to poverty and adverse childhood experiences by fostering informed parenting, child development, and school readiness (Duffee et al., 2017). Benefits of home visiting have been reported in areas of family economic self-sufficiency, birth outcomes, maternal and child health, breastfeeding, child development, and positive parenting practices (Cheng et al., 2019; Minkovitz et al., 2016). Perinatal home visiting programs may also contribute to positive system-level outcomes through reduced service demand associated with poor health and social outcomes, such as reductions in emergency medical use and Child Protective Services investigations among program participants (Goodman et al., 2021).

However, when considered together most studies on perinatal home visiting are determined to be of lower methodological quality; and in those of higher quality, inconsistent findings are common. A systematic review of 71 published research studies, of which 21 were of sufficient quality, notes that an equal number of studies on home visiting report no benefit from program participation as those that report positive impacts (Peacock et al., 2013). Overall benefits tend to be reported in studies with earlier enrollment, more visits, and longer program duration (Peacock et al., 2013), and economic benefit appear to be greatest when targeting those at highest risk (Olds, 2008). The demonstrated benefits of home visiting coupled with the mixed research results highlights the need for population and program-specific outcome evaluation to support evidence-informed program delivery. There is a lack of Canadian-specific evidence.

Among the impacts observed in home visiting program participants in Canada, two qualitative research studies – one study focused on the Canadian Prenatal Nutrition Program (CPNP) in rural Alberta (Quintanilha et al., 2018) and another on the Nurse-Family Partnership (NFP) program in Hamilton, Ontario (Landy et al., 2012) – found that community-based programming such as home visiting can help to alleviate the burden of dealing with adversity in difficult life circumstances and help improve parenting ability among disadvantaged Canadian women. Further, while home visiting has also been shown to have positive impacts on service providers in Canada resulting from the empowerment of supporting families through adversity, negative impacts have also been reported as resulting from the personal stress of the challenges of helping families cope with these crises (Dmytryshyn et al., 2015).

The effectiveness of home visiting programs has not been properly evaluated among Canadian populations (Tough et al., 2006). Each Canadian province and territory offers a home visiting program, several of which are currently undergoing program review, and more research is needed to inform these efforts. Evaluative research in this area is currently being conducted in British Columbia (BC) and in Ontario, specifically to inform on the provision of the NFP program. The recently completed BC Healthy Connection Project (BCHCP) randomized controlled trial will provide valuable Canadian-specific evidence on the impact of home visiting on several maternal, child, and family outcomes (Catherine et al., 2016).

The NFP program tested in the BCHCP was adapted for the Canadian context (Jack, Catherine, et al., 2015; Jack, Sheehan, et al., 2015). As enrollment in BCHCP is limited to the prenatal period and delivery strictly by a public health nurse, the results of the randomized trial may not be generalizable to programs enrolling families postnatally or to those provided by another public health professional. This is an important consideration, as most jurisdictions in Canada prioritize policies on postnatal screening for enrollment and services delivered by other public health professionals.

In New Brunswick, targeted home visiting is delivered by public health nurses as well as dietitians, and while families can be enrolled either prenatally or postnatally, the majority are enrolled postnatally. Therefore, the findings of the research presented in this report are needed to help inform future decision making.

Evaluative research on home visiting is well established in the US, as federal program funding is conditional on the demonstration of evidence-based practice (Minkovitz et al., 2016). The majority well-designed research studies in this area have used a randomized controlled trial (RCT) study design; however, external generalizability of findings can often be questionable. More recently, the use of record linkage studies has as a methodological approach to derive real-world evidence on the long-term impacts of home visiting increased (Cavallaro et al., 2020; Kliem et al., 2018; Lugg-Widger et al., 2020). This is the approach that is used in this research study.

Breastfeeding behaviour and early childhood development are the outcomes examined in this research study. Research on the health advantages of breastfeeding finds decreased incidence of infectious diseases in infancy and related health care utilization, reduced risk of Sudden Infant Death Syndrome (SIDS), preventative health impacts due to lactation, and cost-savings

associated with purchasing infant formula (Heinig, 2001; Paricio Talayero et al., 2006; Pound et al., 2012).

Early childhood development is a fundamental social determinant of health. Development during the first few years of life is well established as a critical window for longer-term outcomes such as academic achievement and employment. Both breastfeeding duration and early childhood development have been examined in the home visiting literature, and overall results are inconsistent, with some studies demonstrating benefits while others do not identify an impact of program participation (Cheng et al., 2019; da Silva et al., 2022; Francis et al., 2021; Robling et al., 2021; Sawyer et al., 2013; Thorland et al., 2017).

To our knowledge, the research presented in this report is the first to use population-based administrative data to inform on the impacts of postnatal home visiting in Canada. This study provides valuable evidence on the short- and longer-term impacts of the Healthy Families, Healthy Babies (HFHB) program, a targeted home visiting program in the province of New Brunswick, Canada. The research study was developed in collaboration with program stakeholders and will be used to directly inform program review efforts in New Brunswick. However, given the scarcity of available Canadian evidence, these results can also provide insights to decisions-makers in other jurisdictions to help inform their program review efforts.

1.2 Program Overview: Healthy Families, Healthy Babies

Healthy Families, Healthy Babies (HFHB) is a public health program that provides prenatal and postnatal services aiming to foster healthy pregnancy and promote healthy development of children up to the age of two years. The program is delivered through the two Regional Health Authorities in New Brunswick and is funded by the Government of New Brunswick's Department of Health.

The HFHB program includes universal and targeted components – universal components being the Public Health Priority Assessment newborn screening and the Healthy Toddler Assessment at 18 months of age. These two assessments are used to screen at the population level to identify families in need of referrals for support services.

The HFHB targeted components are intended to provide supportive services to families with higher risk for poor outcomes. The anticipated program outcomes of targeted services are enhanced fetal/child health and development; enhanced maternal health; increased commitment to healthy lifestyles by families; and use of available community and social supports.

Families can be referred prenatally or identified postnatally via the universal Public Health Priority Assessment newborn screening. Eligibility is based on a score derived from the newborn screening that considers established developmental and family interaction factors.

This research study examines a targeted component of the HFHB program: postnatal home visiting. Home visiting is provided by a public health nurse or dietitian from birth to the age of two

years, and it consists of home-based interventions, including breastfeeding support, in-home visiting, and referral to resources and other programs.

1.3 Research Questions

The overall goal of this research study is to evaluate the short- and longer-term impacts of participation in the HFHB targeted postnatal home visiting program on stakeholder-selected child health and developmental outcomes.

This is achieved by answering the following four research questions, two of which are focused on breastfeeding behaviours and two on child development.

Among eligible families, are babies who participated in postnatal HFHB-targeted services

- More likely than those who did not participate (i) to have longer duration of breastfeeding and (ii) to sustain breastfeeding to the age of 18 months?
- Less likely than those who did not participate (iii) to be identified as having a developmental concern at 18 months of age and/or (iv) to be identified as having significant development difficulty prior to entry into kindergarten?

Methods

2.1 Study Design

A matched retrospective cohort study of all live births in New Brunswick between April 1, 2012, and March 31, 2014, among families parenting for the first time was developed using population-based administrative data. A baseline of 2012 was selected as the HFHB program eligibility criteria were changed in 2011, restricting enrollment to those parenting for the first time. A cohort end of 2014 was selected as this allowed for follow-up of all children up to the time of their school readiness assessment at 4-5 years of age in the spring prior to the start of the COVID-19 pandemic.

Population-based administrative data were accessed at the New Brunswick Institute for Research, Data and Training (NB-IRDT). NB-IRDT is a research institute at the University of New Brunswick and is the sole administrative data repository for the province of New Brunswick. Defined in legislation to receive data from government, private sector, and not-for-profit organizations, NB-IRDT serves as a data custodian for over 100 linkable data sets which are made accessible to researchers through a rigorous application process. The ability to link deidentified personal information across data sets on NB-IRDT's secure platform allows its researchers and partners to perform comprehensive, population-level analyses across large

samples with corresponding control groups. Several linked administrative data sets were used to define the study cohort and HFHB postnatal program participation, as well as breastfeeding and child developmental outcomes at the population level.

The Department of Health's Public Health Priority Assessment (PHPA) data were used to identify all births in New Brunswick between April 1, 2012, and March 31, 2014. The PHPA is a newborn screening program that is a universal component of the HFHB program. The PHPA is performed by a public health nurse in hospital following a baby's birth, or over the phone for those who leave the hospital prior to completing the PHPA. The PHPA has a nearly 100% completion rate. It is comprised of a series of questions that sum to three sub-scores (congenital factors, family interaction, and development factors) and a total score, all of which are used to identify high-risk families in need of referral to support services. Families that get a high PHPA score and are parenting for the first time are eligible for enrollment in the postnatal home visiting program.

The PHPA birth cohort was further restricted to families parenting for the first time using the Department of Health's Discharge Abstract Data (DAD), Vital Statistics, and Citizen Data. DAD contains all records for hospital discharges for individuals with an active New Brunswick Medicare status. All births in New Brunswick are recorded in the DAD, as well as basic demographics, diagnoses/conditions contributing to the length of hospitalization stay, any interventions performed during the hospitalization, and discharge disposition (e.g., sent home, died in hospital, etc.). Any previous births (e.g., alive, still births) between 1995-2012 were identified in the DAD. If a previous birth resulted in parenting for less than six months due to death of the baby, the family was retained in the cohort. Death of a baby was identified using the Vital Statistics death data.

A household identifier in the Department of Health's Citizen Data was also used to identify older children (e.g., those born before 1995 or not born in New Brunswick). The Citizen Data includes all records for operations related to the provincial health care program (i.e., New Brunswick Medicare) between 1971 and 2020, as well as basic demographics (i.e., date of birth, date of death, sex) and address information (i.e., effective and termination dates and corresponding six-digit postal codes).

The final study cohort included families parenting for the first time who were divided into exposed and unexposed groups depending on whether they participated the postnatal home visiting program. The cohort was linked to outcome data at age 18 months and at preschool age (4-5 years). Outcomes were defined for breastfeeding duration and child development at 18 months of age and school readiness at preschool age (4-5 years). A matched design was used to identify a comparable group of non-participating families based on demographic, socioeconomic, and health-related characteristics.

2.2 Study Variables

2.2.1 Exposure Variables

The main exposure variable was defined using HFHB program data provided by Public Health New Brunswick. These data were used to identify the exposed population of families that participated in the HFHB postnatal targeted home visiting program. The unexposed population were those in the cohort who were not identified in the HFHB postnatal program data.

HFHB program data were not previously used for research purposes and required substantial time to clean to enable linking to other administrative data sets. For this reason, prenatal HFHB program data were not considered in this study. It is thus possible that the unexposed population includes families that were enrolled prenatally, but this is unlikely to represent a large number of families, as prenatal participants tend to continue in the program postnatally. The number of postnatal home visits or duration of time in the program postnatally were not considered in defining the main exposure. Duration of time in the program was used to stratify outcomes.

2.2.2 Outcome Variables

Four outcomes were examined. Three shorter-term outcomes were defined using data collected at age 18 months, and one longer-term outcome was defined using data collected at 4-5 years of age. These outcomes were selected in consultation with a large group of program stakeholders from government and both Regional Health Authorities.

The Healthy Toddler Assessment (HTA) is another universal component of the HFHB program. It is a voluntary assessment performed by a public health nurse around the age of 18 months and is available to all families in New Brunswick. The HTA is used to assess a wide range of health and developmental areas of potential concern including accidents/injuries, vision, hearing, oral health, nutrition, parents' mental health, growth, immunizations, and use of community or health services, as well as the validated Ages & Stages Questionnaire (ASQ). Two breastfeeding outcomes were defined using HTA data on nutrition, and a developmental outcome was defined using the ASQ summary scores.

Parents were asked if the child was ever breastfed or fed breast milk, and if they responded yes, they were asked a series of questions about breastfeeding behaviours. Two of these questions were used to define outcomes for duration of breastfeeding: (i) currently breastfed (yes/no) and (ii) duration breastfeeding (in months). They were first asked if they were currently breastfeeding, and if no, they were asked to report the age the child was when he/she completely stopped being breastfed. Those who were currently breastfeeding were assigned a duration of breastfeeding corresponding to the child's age at the HTA. Those that never breastfed or were never fed breast milk were assigned a breastfeeding duration of zero.

Child development at 18 months was assessed using the Ages & Stages Questionnaire (ASQ). The ASQ includes a series of questions designed to capture information from parents about five developmental domains: communication, gross and fine motor skills, problem solving, and personal-social interactions. The ASQ domains each have a total score, with lower scores

representing poorer development. The total scores are categorized into three levels using established cut-offs representing (i) appropriate development, (ii) potential developmental concern, or (iii) developmental concern identified. The main outcome variable was defined using these categories and was restricted to children who were identified as having a developmental concern identified in one or more of the ASQ developmental domains.

Early Years Evaluation Direct Assessment (EYE-DA) data were used to define the longer-term outcome: child development at preschool age (4-5 years). In New Brunswick, prior to entry into kindergarten, families are encouraged to have their child attend a school readiness assessment provided by the Department of Education and Early Childhood Development. The EYE-DA includes a variety of activities intended to capture information from children about five developmental domains: awareness of self and environment, cognitive skills, language and communication skills, and both fine and gross motor skills. Children are scored based on their performance and are placed into one of three categories for each EYE-DA domain, representing (i) appropriate development, (ii) some developmental difficulty, or (iii) significant developmental difficulty. The main outcome variable was defined using these categories, restricting to children who were identified as having significant developmental difficulty in one or more of the domains assessed through the EYE-DA.

2.2.3 Confounding Variables

Given the HFHB home visiting program targets a high-risk population, comparing outcomes among participants to those of all children would not provide a valid estimate of the impact of program participation. To account for differences in exposed and unexposed populations, several confounding variables were derived to identify a comparable group of families that did not participate in the postnatal home visiting program.

Confounding variables included the PHPA scores for family interaction and development factors, maternal demographic and socioeconomic characteristics, maternal prenatal health, and maternal health history. Maternal age, marital status (single, married, or other), immigration status, and use of the Department of Social Development's social assistance income program were all captured at the individual level.

Additionally, neighbourhood-level variables for socioeconomic disadvantage representing increasing levels of material deprivation, residential instability, economic dependency, and ethnocultural composition were measured using the Statistics Canada Canadian Index for Material Deprivation (CIMD).

Specific maternal health variables included previous rapid repeat pregnancy, poor pregnancy outcome (perinatal death, prematurity, or low birth weight), pre-pregnancy type 1 or type 2 diabetes, hypertension, or asthma, as well as gestational diabetes, gestational hypertension, and health service use for mood and/or anxiety disorders.

2.3 Statistical Analyses

A propensity score matching methodology was used to identify a comparable group of families that did not participate in the HFHB postnatal program. The confounding variables described in the previous section were included in a logistic regression model to predict the propensity to participate in the postnatal home visiting program. The model estimates were used to calculate a propensity score for each cohort member. As expected, the overlap in propensity scores between HFHB participants and non-participants was minimal, which provided evidence for the need to control for confounding bias.

A nearest neighbour matching approach was used to select one to two non-participants who had a similar propensity score as a participant. While the intention was to select two non-participants for each participant, due to minimal overlap only one match was possible in most cases. When possible, two matches were included. Confounding variables that remained imbalanced following propensity score matching as well as propensity scores were also included as covariates in multivariable regression models.

Multivariable regression models were used to derive estimates comparing outcomes in those who participated in the postnatal home visiting program to outcome in families that did not participate. Logistic regression was used to model breastfeeding at 18 months and child development at both time points. As a result of the high proportion not initiating breastfeeding at all, a zero inflated Poisson regression was used to model duration of breastfeeding at 18 months. In addition to the propensity score matched regression model analyses, for comparison purposes regression models were also run without matching, but only with adjustment for the propensity score and other measured confounders. Unadjusted models are also presented for comparison purposes but are acknowledged to provide biased estimates of program impacts.

Results

3.1 Study Participants

Of all live births recorded in the hospital Discharge Abstract Data (DAD) during the two-year study period (2012-2014), 6096 families met the criteria (e.g., parenting for the first time) for inclusion in the cohort study. These data were linked with HFHB postnatal program data using unique identifiers for the participant and for their baby. This resulted in 1211 HFHB postnatal program participants with valid identifiers.

The remaining 4885 families were defined as non-participants. A matching procedure was implemented to identify one to two non-participants for each postnatal participant with a similar propensity score (PS) value, which identified 1366 families that were similar to the participant families, serving as a fairer comparison group than all non-participants, given HFHB targets high-risk families.

Table 1 details baseline characteristics for the study cohort (total sample), as well as for each of the three sub-groups of interest: HFHB postnatal participants, all non-participants, and the PS-matched sample. The average age in participants was lower (23.9 years) than for non-participants (27.6 years) but also lower than the PS-matched sample (25.9 years).

In addition to targeting young, first-time parents, eligibility for the HFHB postnatal program is also dependent on family/social, developmental, and congenital factors. A higher percentage of participants were on social assistance (34.9%) and were single (66.1%) than non-participants (9.6% and 39.6%, respectively), and also in relation to the PS-matched sample (21.5% and 35.1%). The PS-matched sample had a higher representation of immigrants than HFHB postnatal participants (8.7% vs. 5.7%).

With respect to health conditions, HFHB postnatal participants were more likely to have a chronic health condition, including diabetes or hypertension (3.1%) and asthma (14.2%), than all non-participants, but percentages were similar in the PS-matched sample (3.0% and 13.2%, respectively). Among postnatal participants, prevalence of gestational diabetes and/or gestational hypertension (2.3%), prior caesarean and/or poor pregnancy outcomes (2.1%), and rapid repeat pregnancy (1.7%), were similar to the PS-matched sample.

The PHPA score is used to determine program eligibility. As expected, postnatal participants were most likely to have a score above ten on the family interaction (40.9%) or the developmental (12.2%) factors score. They were also the least likely to score zero, especially for the family interaction score (10.8% vs. 67.1% in all non-participants and 24.9% in those PS-matched).

At the neighbourhood level, postnatal participants were consistently ranked lowest in the quintile representing better socioeconomic conditions and highest in the quintile representing worse conditions for domains quantifying neighbourhood residential instability, situational vulnerability, and economic dependency.

3.2 Completion Rates

When the study cohort was linked to outcome data, sample sizes were decreased substantially. Table 14 details the completion rates for each study outcome. The completion rate for the 18-month Healthy Toddler Assessment (HTA) was 49% (n=2987) overall. Postnatal participants had the highest HTA completion rate of 58.4% (n=707), which was more similar to non-participants (50.2%, n=2253) and much higher than the PS-matched sample (38.6%, n=527).

Completion rates for the Early Years Evaluation Direct Assessment (EYE-DA) school readiness assessment were much higher (71.7%, n=4372) than completion rates for the HTA. However, unlike what was found for the HTA, postnatal participants had the lowest completion rate for the EYE-DA (63.1%, n=764), slightly lower than the PS-matched sample (67.4%, n=921).

Table 15 presents assessment completion rates in relation to duration in the postnatal program. Duration in the postnatal program was highly associated with completion of the HTA but not the

EYE-DA. Of those enrolled in the program for more than 18 months, over 90% completed the HTA, compared to 49.2% of those with a postnatal program duration of 12-18 months, and less than 40% of those with a program duration of less than 12 months.

3.3 Breastfeeding Duration

Overall, results show postnatal program participation has a positive impact on duration of breastfeeding. There were 707 postnatal participants, 2253 non-participants, and 527 in the PS-matched sample with valid breastfeeding data at the 18-month Healthy Toddler Assessment (HTA). [Tables 2](#) and [3](#) detail the descriptive statistics for breastfeeding outcomes in each group, including duration of breastfeeding (in months) and breastfeeding at 18 months (yes/no).

When examining differences in the duration of breastfeeding between groups, the average duration appeared similar due to the higher proportion of families not initiating breastfeeding at all, or only doing so for a short period of time. The average duration also had large standard deviation, indicating a proportion of the population breastfed for a long duration (i.e., skewed distribution).

When examining duration in categories (≤ 1 month, $>1-6$ months, $>6-12$ months, >12 months; [Table 3](#)), breastfeeding for one month or less was most common for all groups, representing nearly half (48.5%, $n=335$) of postnatal participants, which was higher than in both comparison groups: 43.5% ($n=229$) for the PS-matched sample and 32.7% ($n=723$) for all non-participants.

However, in the >12 month category, postnatal participants were more similar to non-participants (16.1%, $n=111$ and 17.5%, $n=387$, respectively) but had higher rates than the PS-matched sample (12.7%, $n=67$). When examining whether individuals remained breastfeeding at 18 months or not, postnatal participants were found to have the highest breastfeeding rate (10.1%, $n=71$), followed by non-participants (6.6%, $n=148$), the latter of which were more similar to rates in the PS-matched sample (5.9%, $n=31$).

Adjusted multivariable regression models confirmed insights gained from unadjusted descriptive statistics. [Table 2](#) provides results from unadjusted, PS-adjusted, and PS-matched regression models for breastfeeding outcomes, as well as the relevant descriptive statistics. After adjusting for important confounders, postnatal participants were found to breastfeed, on average, 33 days more than non-participants who were similar to them (95% CI: +32 to +35 days).

Due to the high number who did not breastfeed, the regression model used to estimate adjusted average difference in duration of breastfeeding required separating of effects. In addition to modelling the likelihood of breastfeeding for a longer duration (1+ days, count), the likelihood of never breastfeeding (0 days, yes/no) was also estimated.

Postnatal participants were found to have a similar likelihood of never breastfeeding, as the 95% confidence interval (CI) (0.63 to 1.09) included the null value (1.00) of no difference between groups; though, the range does contain more values below 1.00, which suggests that postnatal participants may be more likely to initiate breastfeeding than non-participants who are like

them. We were unable to consider prenatal participation in the analysis, and therefore we are unable to comment on whether those who initiated breastfeeding were more likely to be prenatal participants.

When considering those who remained breastfeeding at 18 months, postnatal participants were found to be 2.25 times more likely (95% CI: 1.55 to 3.26) to be breastfeeding than non-participants like them. Unexpectedly, postnatal participants were also 1.59 times more likely (95% CI: 1.18 to 2.14) to be breastfeeding at 18 months when compared to the average family (unadjusted estimates). However, as compared to the average family, participants were 1.68 times less likely (95% CI: 1.37 to 2.06) to initiate breastfeeding at all, and when they did breastfeed, they do so, on average, for 26 days less (95% CI: 25 to 27).

Breastfeeding outcomes in the target population (postnatal participants and PS-matched sample combined) were examined in relation to key baseline characteristics to gain insights into which characteristics may be associated with better (breastfeeding at 18 months) or worse (never breastfeeding) outcomes. As expected, those who remained breastfeeding at 18 months were represented by better social and health characteristics, whereas those who never breastfed were generally represented by worse social and health characteristics.

Table 4 presents row percentages for each characteristic with the intent to compare between rows within the same column. When examining those who remain breastfeeding at 18 months, these families were less likely to be on social assistance, have single marital status, have a chronic or prenatal health concern or mental health illness, have higher PHPA scores, and be in the worst quintile for economic dependency and situational vulnerability; but they were more likely to be an immigrant. Overall results were generally consistent for those who breastfed but were not breastfeeding at 18 months.

In terms of never breastfeeding, the target population was described as being more likely to be on social assistance, have single marital status, have a chronic or prenatal health concern or mental health illness, and have higher family interaction and developmental PHPA scores; and to be in the worst quintile for economic dependency and situational vulnerability.

Breastfeeding outcomes were also examined by categories for duration of participation in the HFHB postnatal program (0-6 months, >6-12 months, >12-18 months, >18 months) and are presented in Table 5. The largest group of postnatal participants that attended the HTA were those that were in the program for more than 18 months (n=398), 11.6% of which were still breastfeeding at that time. The other three groups were similar in size (n=95-116), and those that were in the program for more than 12 months had the greatest percentage still breastfeeding at 18 months (12.6%, n=12 of 95).

Differences in mean and median duration of breastfeeding are highly weighted by those who breastfed for one month or less or not at all (i.e., 0 days) in all groups, but they were lowest in those that participated in the postnatal program for the shortest duration (0-6 months). Consistently, when examining differences across duration categories, those who participated in the program for the shortest duration had the lowest percentage still breastfeeding at 18 months (9.7%, n=9 vs. 17.4%, n=68 for those who were in the program >18 months).

3.4 Child Development at Age 18 Months

Overall, the results of the study do not provide evidence for a short-term impact of postnatal program participation on development at 18 months ([Table 6](#)).

There were 698 postnatal participants, 2289 non-participants, and 546 in the PS-matched sample with valid Ages & Stages Questionnaire (ASQ) data at the HTA. Most children had scores indicating appropriate development in all five developmental domains. As expected, non-participants were the group with the highest percentage in this category (78.6%), and the PS-matched sample (73.4%) and postnatal participants (71.2%) were more similar to one another.

Postnatal participants also appeared to have the worst outcomes among all three groups, as 9.6% (n=67) of children had a score identifying a developmental concern compared to 5.9% (n=32) of the PS-matched sample and 4.8% (n=110) of all non-participants. Differences across groups were similar in children with scores that identified a potential developmental concern, which was 19.2% in postnatal participants, 20.7% in the PS-matched sample, and 16.7% in non-participants.

[Table 6](#) also presents the results of regression models. As expected, the unadjusted regression model, which compares postnatal participants to all non-participants, suggests that postnatal participants were more than twice as likely to have a developmental concern identified (OR: 2.10, 95% CI: 1.53 to 2.89). However, postnatal participants were as likely as the PS-matched sample to have a developmental concern identified (OR: 1.30, 95% CI: 0.81 to 2.08).

When the development outcome at 18 months was defined by combining those with either a developmental concern or a potential developmental concern, results remained consistent. Postnatal participants were as likely as families like them to have a developmental concern or a potential developmental concern identified (OR: 0.96, 95% CI: 0.73 to 1.25), whereas they were 1.5 times more likely than the average family (all non-participants; OR: 1.47, 95% CI: 1.22 to 1.78).

Developmental outcomes at 18 months were also examined in the target population (postnatal participants and PS-matched sample groups combined) in relation to key baseline characteristics to gain insights into which may be associated with better (appropriate development) or worse (developmental concern identified) outcomes. [Table 7](#) presents row percentages for each characteristic with the intent to compare between rows within the same column. As expected, those who had appropriate development were represented by better social and health characteristics, whereas those who had developmental concerns identified were generally represented by worse social and health characteristics.

When examining children with appropriate development, their families were less likely to be on social assistance, be immigrants, and have a high family interaction PHPA score; whereas children identified with a developmental concern were more likely to be on social assistance, report a prenatal health concern (poor pregnancy outcome), have a high family interaction PHPA score, and live in areas with high residential instability and ethno-cultural composition.

Developmental outcomes at 18 months were also examined by categories for duration of participation in the HFHB postnatal program (0-6 months, >6-12 months, >12-18 months, >18 months) and are presented in [Table 8](#). Though numbers were small for shorter program duration, results were overall consistent across duration categories. The largest group of postnatal participants was those that were in the postnatal program for more than 18 months (n=392), and the smallest group was in the program for 12-18 months (n=94).

The percentage of children with appropriate development was similar across the four duration categories (70-75%), with those in the 6-12 months duration category having the highest percentage (75.4%). Results were also similar across duration categories among those with a developmental concern identified (7-10%), with the duration category of 6-12 months having the lowest percentage (7.0%, n=8), and those in the program the shortest (0-6 months) and longest (>18 months) durations having the highest percentage (10.2%).

3.5 School Readiness at Age 4-5 Years

Similar to child development at 18 months, study results did not demonstrate a significant long-term impact on school readiness for postnatal participants in the HFHB program ([Table 9](#)). There were 764 postnatal participants, 3608 non-participants, and 921 in the PS-matched sample that had valid data on the Early Year Evaluation Direct Assessment (EYE-DA) school readiness evaluation.

Postnatal participants were the group with the highest percentage of children having significant difficulty in at least one of five domains (40.6%) and the lowest percentage reporting appropriate development (38.8%), which was similar to the PS-matched sample (35.9% and 43.7%, respectively) but worse than was observed in all non-participants (27.0% and 52.1%). The percentage reporting some difficulty was similar across all three groups (20.4% to 21.9%).

Results obtained from regression modelling also presented in [Table 9](#) demonstrate that, compared to the average family (all non-participants), postnatal participants were nearly twice as likely (OR: 1.85, 95% CI: 1.57 to 2.17) to have a significant difficulty identified in at least one of five developmental domains on the EYE-DA, whereas they were as likely as families like them (OR: 1.09, 95% CI: 0.89 to 1.33).

When the school readiness outcome was defined by combining children who were found to have significant or some developmental difficulty, results were similar. Postnatal participants were as likely as families like them (OR: 1.03, 95% CI: 0.85 to 1.25), but nearly two times more likely than the average family (non-participants; OR: 1.71, 95% CI: 1.46 to 2.01), to have significant or some developmental difficulty.

School readiness was also examined in the target population (postnatal participants and PS-matched sample groups combined) in relation to key baseline characteristics to gain insights into characteristics that may be associated with better (appropriate development) or worse (significant difficulty) outcomes. [Table 10](#) presents row percentages for each characteristic, with the intent to be compared between rows within the same column. As was found for the other

outcomes, those who had appropriate development were represented by better social and health characteristics, whereas those who had difficulty identified were generally represented by worse social and health characteristics.

When examining children with appropriate development, their families were less likely to be on social assistance and living in areas represented by the highest residential insecurity, economic dependency, and situational vulnerability; their mothers were less likely to have a mental illness or chronic health condition before pregnancy, or to have a high score on both the developmental and family interaction PHPA scores, and more likely to be married and to have a prenatal health concern (e.g., gestational diabetes).

The opposite was found for children identified as having significant difficulty. Their families were more likely to be on social assistance and living in areas represented by the highest residential insecurity, economic dependency, and situational vulnerability; their mothers were more likely to have a chronic health condition, a prenatal health concern, and/or a high development and family interaction PHPA score. Immigrant families were most highly represented in the group of children identified as having appropriate development as well as significant difficulty, and among the least represented in the group identified as having some difficulty.

When school readiness was examined with respect to duration in the postnatal program, results were more variable than was observed for development at 18 months, as shown in [Table 11](#). As with the HTA, those in the postnatal program for more than 18 months were most likely to have valid EYE-DA data (n=279). Those enrolled in the program for 12-18 months had the highest percentage of children with appropriate development (44.6%, n=54) and the lowest percentage with significant difficulty (33.9%, n=41). The lowest percentage of children with appropriate development were those enrolled 6-12 months postnatally (34.7%, n=67), and the group with the highest percentage having significant difficulty were those enrolled for the lowest duration (44.4%, n=124).

As the 18-month HTA developmental assessment is completed with the intention of referring families to appropriate services to improve child development in areas of concern, there was interest in understanding whether completing the 18-month developmental assessment was associated with different developmental outcomes at the time of entry into kindergarten. This was examined in both the entire study cohort ([Table 12](#)) and specifically in the target population ([Table 13](#); postnatal participants and PS-matched sample combined). Results were similar in both analyses, which suggested better outcomes in those who completed the assessment and worse outcomes in those who did not complete the assessment.

Those who completed the 18-month assessment were more likely to have appropriate development and were less likely to have significant difficulty than those who did not complete the assessment. In the target population, 44.2% (n=386) of those who completed the assessment had appropriate development, compared to 38.6% (n=313) of those who did not complete the assessment; whereas 35.8% (n=313) of those who completed it had significant difficulty compared to 40.4% (n=328) who did not.

Discussion

4.1 Summary of Findings

A birth cohort of 6096 families parenting for the first time was established and followed longitudinally from birth to school age using population-based linked administrative data. This study design was used to evaluate the short- and longer-term impacts of participation in the Healthy Families, Healthy Babies (HFHB) targeted postnatal home visiting program in the Canadian province of New Brunswick. The cohort included 1211 families that participated in the HFHB program postnatally.

As the HFHB targeted services have very specific eligibility criteria (i.e., high-risk families), it was critical to identify a similar group of families that did not participate in the program. This was done using a specialized statistical methodology (propensity score matching) that combined relevant demographic, socioeconomic, and health data to select non-participants who were most similar to participants based on these data. The goal was to select two non-participants for each participant, but as participants represented a very high-risk population, in most cases it was only possible to select one match.

There were 1366 matched non-participants included in the analysis. This provides credence of the program's reach, as the highest-risk families were those that were enrolled. However, this meant there were not many non-participants with high propensity scores, which limited the ability to match the participants with highest risk. Based on this, residual confounding was expected, and further statistical adjustments were made in final regression models for variables included in the propensity score model. Based on this finding, it may be expected that outcomes in participants may appear worse than matched non-participants due to differences in population characteristics.

It was therefore interesting that postnatal participants had a longer duration of breastfeeding than matched non-participants. On average, postnatal participants breastfed for 33 days longer and were twice as likely to be breastfeeding at age 18 months (10.1% vs 5.5%). This was a remarkable finding, as postnatal participants were also nearly twice as likely to sustain breastfeeding to 18 months when compared to the average family (6.6%). However, the HFHB postnatal participants also had the highest percentage that breastfed for only one month.

Nutritional support is a large focus on the HFHB home visiting program, and thus longer duration of breastfeeding was an anticipated impact of participating in the program; however, the extent was not previously known. This research study provided among the first Canadian evidence to demonstrate the impact of targeted postnatal home visiting on breastfeeding behaviours in high-risk families. However, the results leave questions about the impact of prenatal enrollment, which will be the focus of future research.

Several universal screening programs in New Brunswick are intended to support healthy child development, including the Healthy Toddler Assessment and the Early Year Evaluation Direct Assessment (EYE-DA). The Healthy Toddler Assessment is used by Public Health in New Brunswick

to screen children for developmental concerns at the age of 18 months using the Ages & Stages Questionnaire (ASQ). Similarly, at the age of 4-5 years, the EYE-DA is used by the school district to screen children for any developmental difficulties prior to entry into kindergarten. Summary scores from each assessment trigger referrals to specialized and/or community-based services intended to support families and the child's development.

Participation in the HFHB postnatal home visiting program was not found to have an impact on child development in toddlers or in preschoolers. Participants were as likely as matched non-participants to have developmental concerns identified at 18 months in communication, problem solving, personal-social interactions, and physical development (gross motor and fine motor skills). They were also as likely to have significant difficulty in awareness of self and their environment, cognitive skill, language/communication skills, and physical development. On average, postnatal participants were found to have poorer developmental outcomes than matched non-participants, but when considering statistical variability, no difference in outcomes was suggested.

While not a direct outcome of the postnatal program, a positive impact on child development was anticipated given the services are oriented on fostering healthy development and referral to specialized services. However, due to the high-risk population targeted for enrollment in the HFHB postnatal home visiting program, more focused and integrated services may be required to meaningfully impact child development.

4.2 Discussion of Findings

This is among the first population-based Canadian research studies to evaluate the impact of targeted postnatal home visiting on breastfeeding behaviour and on child development. In addition, this is among the few studies to inform on the long-term impact of home visiting. This work helps to fill a significant gap in the scientific literature.

While postnatal home visiting is offered in every province and territory across Canada, research on program impact is very limited. The recently completed BC Healthy Connection Project (BCHCP) will provide valuable evidence on the impact of participation in the Nurse-Family Partnership (NFP) home visiting program on maternal, child, and family outcomes up to the age of two years. The NFP program has also been implemented in Ontario in several Health Units (Jack et al., 2019); it is also undergoing evaluation and will supplement knowledge from the BCHCP. However, while the NFP has a long history of evidence-based practice in the US and is thus likely to have positive impacts in Canada, it is unlikely that it will be adopted in every jurisdiction due to the intensity of the program. Therefore, research on alternate delivery models is needed to inform decision making.

Many existing programs in Canada include a postnatal home visiting component, and thus the findings of this research study provide necessary evidence for policy makers to consider in reviewing their programs – though, more research is needed to better understand the relationships between home visiting and outcomes among Canadian families. With increasing access to data for research purposes, the use of record linkage methods like the one used in this

research study will prove invaluable to helping understand the needs of new, at-risk families. Several protocols for studies have recently been published. Without the need to conduct expensive, time-consuming randomized controlled trials, researchers can derive evidence on various outcomes simultaneously.

The ability to use population-based data increases the validity of study results, though this is highly dependent on the availability of robust data to support evaluation efforts. In Canada, the establishment of provincial research data centres like NB-IRDT and the Health Data Research Network will enable researchers to derive robust Canadian-specific evidence with fewer resources. In New Brunswick, the availability of the HFHB program data through NB-IRDT made it possible to conduct this research study province-wide; however, in provinces where data are not centralized, this type of research may not be possible. More focus on data development is needed to facilitate high-quality, robust, impact-evaluative research.

A large amount of research on the impact of home visiting has been conducted in the US and more recently internationally. A systematic review of 71 published research studies examining impacts of home visiting found the majority studies were of poor quality and reported on shorter-term outcomes. In the 21 studies of sufficient quality, a similar number reported no benefit as reported positive impacts. However, overall benefits tended to be reported in studies with earlier enrollment (prenatally preferably) and higher dose (more visits) for longer duration (more exposure to the program) (Peacock et al., 2013).

Overall existing research on home visiting is consistent with the findings of this research study, which suggests positive impacts on breastfeeding behaviours and no evidence for impacts on child development.

Most research on breastfeeding is focused on initiation and exclusivity, demonstrating positive impacts of prenatal home visiting on initiation and the need for early postnatal home visiting to promote exclusivity. A very large US study (Thorland et al., 2017) that examined nearly 30 000 NFP participants found they were more likely to maintain breastfeeding at 6 and 12 months but were less likely to exclusively breastfeed, as compared to a national survey of children's health data.

A recent evaluation of the Canadian Prenatal Nutrition Program (CPNP), a program that aims to address socioeconomically vulnerable families, found high rates of breastfeeding for 6 months (84%) when utilizing home visiting with a lactation consultant (Francis et al., 2021).

A recent review on the effects of home-based interventions identified 16 studies reporting on duration of breastfeeding, four of which found positive impacts (Cheng et al., 2019). Only one of these studies examined breastfeeding duration at 18 months, as was examined in this study. Similarly, a positive impact on duration was found; however, duration of breastfeeding was substantially longer in their study as compared to this study.

An older Cochrane review (Yonemoto et al., 2017) on the timing of home visiting identified some evidence that a greater number of visits postpartum may promote exclusive breastfeeding. A more recent quantitative analysis identified that breastfeeding duration increased with a higher number of home visits during which breastfeeding is discussed, highlighting the importance of

prenatal enrollment and duration of postnatal visiting on breastfeeding behaviours (McGinnis et al., 2018). Nutrition is an important focus of the HFHB program, which may explain the positive findings in this study relative to other studies that have not identified an association.

Limited research that has examined longer-term outcomes and impacts of home visiting on child development has also been inconsistent. A series of robust research studies in Australia did not identify an impact of postnatal home visiting on child development (Sawyer et al., 2013). No differences were found in toddlers' social and emotional development using the Ages & Stages Questionnaire Social and Emotional Questionnaire (ASQ-SE) when comparing those randomized to a home visiting program modelled after the NFP postnatal components. Results were similar when restricting to rural residents (Sawyer et al., 2014).

In another randomized control trial by the same research group, no differences in school readiness at age five years were noted (Sawyer et al., 2019). Using a record linkage approach to emulate their trial design, this group has further demonstrated no evidence of program impact on child development at ages five or nine years (Moreno-Betancur et al., 2023, February).

In contrast, a UK study that evaluated the impact of NFP on school readiness demonstrated a significant impact (Robling et al., 2021). Three older research studies from the US, also evaluating the NFP, found better developmental outcomes in children at ages four, six, and nine years (Olds, 2008). A recent Brazilian population-based birth cohort study found no impact of home visiting on childhood development at age four years, overall, except when restricting to those who were enrolled during pregnancy (da Silva et al., 2022).

There is also limited research on the impacts of the timing of program enrollment, and on the duration and intensity of home visiting. Discussion of early enrollment in home visiting is pervasive in the literature as a means to improve outcomes in at-risk populations. In the current study, it was not possible to compare outcomes of prenatal to postnatal participants, but this an area of interest for future research. More research is also needed to derive evidence on the impacts of program duration and intensity. While this was not a focus of this study, summary statistics are presented for each outcome by program duration. The findings were overall consistent with the literature, suggesting positive impacts associated with longer duration (Peacock et al., 2013).

4.3 Study Strengths and Limitations

There are several strengths and limitations of this research study. The strengths of the study include the use of population-based data, large sample sizes, propensity score matching, consideration of multiple outcomes, and a long-term follow-up. The main limitations of this research are the reliance on messy data not created for research purposes, lack of individual-level data on key confounding variables, inability to identify non-participant matches for highest-risk participants, missing outcome data for those attending 18-month and school readiness assessments, and finally the COVID-19 pandemic impacting school readiness assessment data from children born after 2014, as discussed further below.

4.3.1 Strengths

This study used population-based administrative data that enabled sampling from the entire population of New Brunswick. The availability of population-based administrative data, made accessible for research purposes through provincial data centres such as NB-IRDT, enables researchers to examine health impacts in unbiased population-based samples, as the sampling frame includes all residents of the province.

Data collected as part of the universal newborn screening component of the HFHB program was used to sample cohort members in this study. As health care in New Brunswick is publicly funded and all residents are eligible for a provincial health care card from birth, this study included all births in the province between April 1, 2012, and March 31, 2014.

The use of population-based data sources also inherently provides access to large sample sizes. This is an advantage over randomized controlled trials (RCTs). As RCTs necessitate prospective follow-up, the number of research participants that can be enrolled in a study is limited by many factors. The BC Healthy Connections Project aimed to enroll over 1000 participants but stopped enrollment at 739, half of which were randomized to the usual care group. In this study, there were 1211 HFHB postnatal participants who were compared to 1366 higher-risk families that received usual care (i.e., non-participants). This is a substantial increase in sample size over previous research.

The use of propensity score methodology is another important strength of this research study. Confounding bias relates to the mixing or confusion of effects. When comparison groups have different characteristics, the results obtained may be due to group differences. For this reason, propensity score methodology was used to identify a comparable group of non-participants. The use of methodological approaches to estimate program impacts have become more common in the literature on home visiting (da Silva et al., 2022; Sawyer et al., 2019). Propensity score matching was also used in a recent Brazilian birth cohort study examining child development at age four years (da Silva et al., 2022). As those data were collected via self-report assessment, a greater number of relevant confounders were considered than was possible in this study, such as individual-level socioeconomic data or paternal information.

The ability to link data from different government departments allowed for long-term follow-up enabling the evaluation of outcomes that would be difficult to do prospectively. This is a key reason research in this area has typically focused on evaluating short-term outcomes, given the resources needed to maintain contact with families over long durations of time. In this study, families were followed longitudinally in administrative data from birth up to the age of school entry. The ability to link primary study data and administrative data will also enable research studies, such as the BC Healthy Connections Project, to continue following families prospectively, even after the RCT ends. However, this will require time to pass as children age.

The impact on longer-term outcomes is an important knowledge gap in the research literature. More research in this area is expected with the establishment of administrative data centres. Recent research from Australia, England, and Brazil provides evidence on program impacts beyond the ages examined in this study (da Silva et al., 2022; Moreno-Betancur et al., 2023,

February; Robling et al., 2021). One US study that evaluated the long-term impact of the NFP demonstrated positive impacts on cognitive and behavioural outcomes at age 18 years (Kitzman et al., 2019).

Data from the Department of Education and Early Childhood Development are available at NB-IRDT to enable longer-term follow-up into primary school, high school, and beyond.

4.3.2 Limitations

The main limitation of this research study is the reliance on data not created for research purposes. The Healthy Families, Healthy Babies (HFHB) program data are stored in an older system that is used by Public Health staff for the purposes of delivering the HFHB program, but it was never designed to be used for research purposes. The data were difficult to pull from the system, to prepare for data linkage, and to use, as they were composed of many related tables. In many cases, there were errors in either the participant or baby identifiers, which required manual correction to enable record linkage with other data sets. For this reason, only postnatal HFHB program data were examined. Recently secured funding will enable further research on HFHB prenatal participation, with a focus on nutrition using comprehensive Healthy Toddler Assessment data. This will include evaluation using the NutriSTEP (Simpson et al., 2015), a validated screening tool used by Public Health to identify nutritional issues in toddlers.

Once data were linkable, missing information in the HFHB Public Health Priority Assessment (PHPA) data was another limitation of this research study. The individual PHPA items were planned to be used in deriving propensity scores, but as a result of missing data, only summary scores could be used in the analysis. The individual items contain a lot of information about families and would have been informative to use in identifying a comparable group of non-participant families. More complete data would have also improved the matching of participants to non-participants in this study. Missing, incomplete, or inconsistent data are key limitations of using data that were not previously collected for research purposes. Enhancing data capture systems to ensure completeness and facilitate retrieval is needed to increase the rigour of research using administrative data.

In addition, administrative data often also lack key information about individual-level socioeconomic information. Poverty is a major social determinant of health and is highly correlated with eligibility for HFHB postnatal home visiting. Poverty was measured using a variable for income assistance from the Department of Social Development, as well as Statistics Canada Census measures of median area-level income. However, there are a wide range of high-risk families that are not on social assistance. Socioeconomically disadvantaged women were found to be more likely to need financial support but less likely to receive it than socioeconomically advantaged women. Therefore, measurement of poverty in this study may have not adequately captured individual experiences. Linkage to Canada Revenue Agency tax file data would have provided a better measure of accessible family income.

While propensity scores help to identify a comparable group of families, there was a substantially lower number of non-participants with the highest scores. Therefore, propensity score matching was more difficult for participants with the highest scores. This demonstrated that the most high-

risk families were enrolled in the program. This may have impacted results in the direction of participants appearing to have worse outcomes than non-participants. Therefore, it may be expected that a longer duration of breastfeeding, and percentage breastfeeding at 18 months, may have been higher than reported in this study. Given the range of the confidence interval from the regression models for child development, this is unlikely to change the final result.

The Australian record linkage study previously mentioned found negative impacts of program participation for some outcomes (Sawyer et al., 2019). As it is unlikely for the program to negatively impact families, this may relate to the inability to identify a comparable group of non-participant families. This will be a concern for the evaluation of any program when using a record linkage study. However, better matching at the higher end of propensity scores may not be possible for this population.

Missing outcome data was another limitation that may have biased the study results. When linking to outcome data, sample sizes decreased by one-third for the school readiness assessment and by one-half for the 18-month assessment. Both the Healthy Toddler Assessment (HTA) and Early Years Evaluation Direct Assessment (EYE-DA) are universal and are encouraged using different strategies, but participation is voluntary. There was an extremely high response rate for the HTA among the postnatal participants; however, this is most likely due to the fact that the assessment is completed in the family's home, during a home visit, while the non-participant families attend community health centres to complete the assessments through appointments with local Public Health offices.

The poor completion rate, especially for the HTA, may have resulted in biased study results. If, for example, the matched non-participants who did not attend the assessment were more likely to have a developmental concern identified, but the participants were more likely to undergo the assessment, those who may not otherwise have attended are captured in the sample. The completion rates of the school readiness assessment were substantially higher, and results on child development were consistent at both time points.

Report card data for all school grades and for public post-secondary institutions are also available at NB-IRDT and do not include any missing data. These could be considered in future research on child development to capture a full population-based sample. However, this was not possible in this study due to the COVID-19 pandemic. All assessments that were used in this study were impacted by public health restrictions, and thus their data quality is questionable. A birth cohort range of 2012 to 2014 was used to capture all children undergoing their school readiness assessment in the spring of 2019 or earlier. While a wider period would have allowed for a larger sample size, changes in practices may render comparison of data pre- and post-pandemic more difficult.

4.4 Conclusions

Postnatal home visiting was found to have a positive impact on breastfeeding duration among vulnerable Canadian families, though no impacts on early childhood development were found. This research study is among the first in Canada to derive evidence that is needed to inform

delivery of home visiting programs. While research from other countries offers support for the positive impacts of home visiting on vulnerable families, research that can be directly generalized to Canadian families is desperately needed. The opportunity to conduct research in partnership with HFHB program stakeholders ensured findings were applicable to program review efforts. The research methodology used in this research study provides a robust model for subsequent research studies to build from in developing a knowledge base of evidence on long-term impacts of home visiting in Canada.

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Baseline Characteristics

Table 1: Baseline characteristics of study cohort

Baseline Characteristic, % (n)	Total Sample (n=6096)	Non-Participants (n=4885)	HFHB Postnatal Participants (n=1211)	PS-Matched Sample (n=1366)
Age at Birth^a	26.8 (5.5)	27.6 (5.1)	23.9 (6.0)	25.9 (5.8)
Social Assistance	14.6% (891)	9.6% (468)	34.9% (423)	21.5% (293)
Marital Status				
Married	48.3% (2945)	53.4% (2610)	27.7% (335)	35.1% (480)
Single	44.9% (2734)	39.6% (1933)	66.1% (801)	58.4% (797)
Other	6.8% (417)	7.0% (342)	6.2% (75)	6.5% (89)
Immigrant	4.9% (300)	4.7% (231)	5.7% (69)	8.7% (119)
Diabetes or Hypertension	2.8% (173)	2.8% (135)	3.1% (38)	3.0% (41)
Asthma	10.7% (654)	9.9% (482)	14.2% (172)	13.2% (182)
Gestational Diabetes/ Hypertension	1.5% (92)	1.3% (65)	2.3% (27)	2.3% (31)
Prior Caesarean/ Poor Pregnancy Outcome	1.2% (73)	1.0% (48)	2.1% (25)	1.8% (24)
Rapid Repeat Pregnancy	1.5% (92)	1.5% (71)	1.7% (21)	1.5% (20)
Family Interaction PHPA Score				
0	55.9% (3410)	67.1% (3279)	10.8% (131)	24.9% (340)
1 to 10	31.7% (1934)	27.6% (1349)	48.3% (585)	57.0% (779)
>10	12.3% (752)	5.3% (257)	40.9% (495)	18.1% (247)
Developmental PHPA Score				
0	69.4% (4232)	75.5% (3688)	44.9% (544)	54.0% (738)
1 to 10	26.1% (1588)	21.9% (1069)	42.9% (519)	37.2% (509)
>10	4.5% (276)	2.6% (128)	12.2% (148)	8.7% (119)
Area-Level Residential Instability Quintile				
1 st	18.5% (1126)	19.7% (962)	13.5% (164)	14.5% (198)
2 nd	19.2% (1169)	19.6% (955)	17.7% (214)	18.7% (255)
3 rd	19.1% (1167)	19.7% (963)	16.9% (204)	17.6% (241)
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Baseline Characteristic, % (n)	Total Sample (n=6096)	Non-Participants (n=4885)	HFHB Postnatal Participants (n=1211)	PS-Matched Sample (n=1366)
4 th	21.6% (1315)	21.4% (1045)	22.3% (270)	21.9% (299)
5 th	21.6% (1319)	19.7% (960)	29.6% (359)	27.3% (373)
Area-Level Economic Dependency Quintile				
1 st	29.7% (1809)	31.2% (1522)	23.7% (287)	25.8% (353)
2 nd	25.3% (1543)	25.3% (1234)	25.5% (309)	23.9% (327)
3 rd	18.0% (1098)	18.0% (879)	18.1% (219)	18.7% (255)
4 th	17.0% (1035)	16.3% (796)	19.7% (239)	19.3% (264)
5 th	10.0% (611)	9.3% (454)	13.0% (157)	12.2% (167)
Area-Level Ethno-Cultural Composition Quintile				
1 st	13.4% (817)	12.6% (616)	16.6% (201)	14.2% (194)
2 nd	16.8% (1022)	16.7% (817)	16.9% (205)	15.7% (215)
3 rd	22.8% (1388)	23.7% (1157)	19.1% (231)	22.0% (300)
4 th	21.1% (1288)	21.2% (1034)	21.0% (254)	20.9% (285)
5 th	25.9% (1581)	25.8% (1261)	26.4% (320)	27.2% (372)
Area-Level Situational Vulnerability Quintile				
1 st	30.2% (1842)	32.5% (1586)	21.1% (256)	25.0% (341)
2 nd	21.7% (1320)	21.7% (1059)	21.6% (261)	22.0% (300)
3 rd	18.1% (1102)	18.0% (880)	18.3% (222)	17.9% (244)
4 th	17.9% (1089)	16.8% (821)	22.1% (268)	19.8% (271)
5 th	12.2% (743)	11.0% (539)	16.9% (204)	15.4% (210)

a. Mean (standard deviation)

Breastfeeding Outcomes at Age 18 Months

Table 2: Regression model results evaluating impact of HFHB postnatal program participation on breastfeeding outcomes

Outcome	Non-Participants (n=2253)	HFHB Postnatal Participants (n=707)	PS-Matched Sample (n=527)	Unadjusted (95% CI ^b)	PS-Adjusted ^b (95% CI)	PS-Matched ^b (95% CI)
Breastfeeding at 18 Mos	6.6% (148)	10.1% (71)	5.9% (31)	1.59 ^c (1.18 to 2.14)	2.25 ^c (1.55 to 3.26)	2.27 ^c (1.41 to 3.67)
Age Stopped Breastfeeding^a	5.9 (6.1) mos	4.9 (6.3) mos	4.8 (5.8) mos	-26 days (-25 to -27)	+33 days (+32 to +35)	+34 days (+32 to +36)
Never Breastfed	16.6% (375)	25.0% (177)	Not released	1.68 ^c (1.37 to 2.06)	0.83 ^c (0.63 to 1.09)	0.79 ^c (0.58 to 1.06)

a. Mean (standard deviation)

b. CI: confidence interval; PS: propensity score; PS-adjusted: PS included as covariate; PS-matched: each HFHB postnatal program participant was matched to 1 or 2 non-participants

c. Odds ratio (OR); greater than 1.00 suggests HFHB postnatal program participants are more likely than the comparison group; less than 1.00 suggest HFHB postnatal program participants are less likely than the comparison group.

Table 3: Duration of breastfeeding at age 18 months among study cohort

Duration, % (n)	Total Sample (n=2901)	Non-Participants (n=2210)	HFHB Postnatal Participants (n=691)	PS-Matched Sample (n=527)
1 month or less	36.5% (1058)	32.7% (723)	48.5% (335)	43.5% (229)
>1-6 months	25.6% (743)	26.5% (585)	22.9% (158)	27.3% (144)
>6-12 months	20.8% (602)	23.3% (515)	12.6% (87)	16.5% (87)
>12 months	17.2% (498)	17.5% (387)	16.1% (111)	12.7% (67)

Table 4: Breastfeeding outcomes at age 18 months in relation to baseline characteristics among the HFHB postnatal program participants and PS-matched sample combined

Baseline Characteristic, % (n)	Breastfeeding at 18 Mos (n=100)	Previously, but not at 18 Mos (n=835)	Never Breastfed (n=302)
Social Assistance			
Yes	5.3% (18)	57.6% (197)	37.1% (127)
No	9.2% (82)	71.3% (638)	19.6% (175)
Marital Status			
Married	13.3% (56)	73.0% (308)	13.7% (58)
Single	5.1% (38)	64.8% (484)	30.1% (225)
Other	8.8% (6)	63.2% (43)	27.9% (19)
Immigrant^a			
Yes	22.5% (18)	77.5% (62)	
No	7.1% (82)	92.9% (1075)	
Chronic/Prenatal Health Concerns^b			
Yes	6.8% (18)	60.5% (161)	32.7% (87)
No	8.4% (82)	69.4% (674)	22.1% (215)
Mental Illness			
Yes	7.8% (75)	66.7% (639)	25.5% (244)
No	9.0% (25)	70.3% (196)	20.8% (58)
Developmental PHPA^c Score			
0	7.8% (51)	67.6% (441)	24.5% (160)
1 to 10	9.2% (44)	68.5% (326)	22.3% (106)
>10	4.6% (5)	62.4% (68)	33.0% (36)
Family Interaction PHPA Score			
0	9.0% (24)	77.1% (205)	13.9% (37)
1 to 10	8.4% (54)	69.1% (445)	22.5% (145)
>10	6.7% (22)	56.6% (185)	36.7% (120)
Area-Level Residential Instability Quintile			
1 st	6.4% (12)	71.7% (134)	21.9% (41)
2 nd	7.0% (17)	67.1% (164)	25.8% (63)
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Baseline Characteristic, % (n)	Breastfeeding at 18 Mos (n=100)	Previously, but not at 18 Mos (n=835)	Never Breastfed (n=302)
3 rd	7.2% (16)	70.1% (155)	22.6% (50)
4 th	9.7% (28)	65.1% (188)	25.3% (73)
5 th	9.1% (27)	65.5% (194)	25.3% (75)
Area-Level Economic Dependency Quintile			
1 st	10.2% (26)	72.3% (185)	17.6% (45)
2 nd	8.2% (24)	70.3% (206)	21.5% (63)
3 rd	7.2% (17)	66.8% (157)	26.0% (61)
4 th	8.2% (22)	66.0% (177)	22.9% (69)
5 th	5.9% (11)	59.5% (110)	25.6% (64)
Area-Level Ethno-Cultural Composition Quintile			
1 st	4.1% (10)	65.0% (160)	30.9% (76)
2 nd	5.6% (11)	68.7% (136)	25.8% (51)
3 rd	7.4% (18)	68.0% (166)	24.6% (60)
4 th	10.4% (26)	68.0% (170)	21.6% (54)
5 th	11.7% (35)	67.9% (203)	20.4% (61)
Area-Level Situational Vulnerability Quintile			
1 st	9.4% (26)	70.9% (197)	19.8% (55)
2 nd	10.9% (28)	70.5% (182)	18.6% (48)
3 rd	8.7% (19)	63.0% (138)	28.3% (62)
4 th	7.6% (19)	68.1% (171)	24.3% (61)
5 th	3.5% (8)	63.6% (147)	32.9% (76)

- a. "Not Breastfeeding at HTA but Previously Breastfed" and "Never Breastfed" were combined due to low cell sizes for immigrants.
- b. Chronic/Prenatal Health Concerns includes diabetes, hypertension, gestational diabetes, gestational hypertension, asthma, a caesarean section, or a poor pregnancy outcome before time of birth.
- c. PHPA: Public Health Priority Assessment

Table 5: Breastfeeding outcomes among HFHB postnatal participants by postnatal duration in program

Outcome	0-6 Mos	>6-12 Mos	>12-18 Mos	>18 Mos
Breastfeeding at 18 Mos, % (n)	8.6% (6)	6.0 % (7)	12.6% (12)	11.6% (46)
Not Breastfeeding at 18 Mos, % (n)	93.8% (91)	94.0% (109)	87.4% (83)	88.4% (352)
Age Stopped Breastfeeding				
Mean (Standard Deviation)	3.9 (5.5) mos	5.0 (6.0) mos	5.9 (6.6) mos	4.9 (6.4) mos
Median	1 month	1.5 mos	3 mos	1.5 mos
1 Month or Less*	53.8% (50)	48.7% (55)	41.9% (39)	48.7% (191)
>1-6 Mos	25.8% (24)	18.6% (21)	23.7% (22)	23.2% (91)
>6-12 Mos	10.8% (10)	18.6% (21)	15.1% (14)	10.7% (42)
>12 Mos	9.7% (9)	14.2% (16)	19.4% (18)	17.4% (68)

* Includes those who never breastfed (0 days)

Child Development at Age 18 Months

Table 6: Regression model results evaluating impact of HFHB postnatal program participation on child development at age 18 months, measured using the Ages & Stages Questionnaire (ASQ)

ASQ Outcome	Non-Participants (n=2289)	HFHB Postnatal Participants (n=698)	PS-Matched Sample (n=546)	Unadjusted OR ^b (95% CI ^b)	PS-Adjusted ^b OR (95% CI)	PS-Matched ^b OR (95% CI)
Developmental Concern	4.8% (110)	9.6% (67)	5.9% (32)	2.10 (1.53 to 2.89)	1.26 (0.83 to 1.91)	1.30 (0.81 to 2.08)
Potential Concern	16.7% (383)	19.2% (134)	20.7% (113)	1.47 ^a (1.22 to 1.78)	1.06 ^a (0.83 to 1.36)	0.96 ^a (0.73 to 1.25)
Appropriate Development	78.5% (1796)	71.2% (497)	73.4% (401)	Reference	Reference	Reference

a. Modelled as grey or any dark, compared to all white

b. CI: confidence interval; OR: odds ratio; PS: propensity score; PS-adjusted: PS included as covariate; PS-matched: each HFHB postnatal program participant was matched to 1 or 2 non-participants

Table 7: Child development at age 18 months, as measured using the Ages & Stages Questionnaire, in relation to baseline characteristics among the HFHB postnatal program participants and PS-matched sample combined

Baseline Characteristic, % (n)	Appropriate Development (n=898)	Potential Developmental Concern (n=247)	Developmental Concern (n=99)
Social Assistance			
Yes	69.5% (244)	20.8% (73)	9.7% (34)
No	73.2% (654)	19.5% (174)	7.3% (65)
Marital Status			
Married	72.3% (308)	19.5% (83)	8.2% (35)
Single	72.3% (540)	20.1% (150)	7.6% (57)
Other	70.4% (50)	19.7% (14)	9.9% (7)
Immigrant			
Yes	67.5% (54)	25.0% (20)	7.5% (6)
No	72.5% (844)	19.5% (227)	8.0% (93)
Prenatal Health Concern^a			
Yes	71.7% (43)	11.7% (7)	16.7% (10)
No	72.2% (855)	20.3% (240)	7.5% (89)

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Baseline Characteristic, % (n)	Appropriate Development (n=898)	Potential Developmental Concern (n=247)	Developmental Concern (n=99)
Chronic Disease^b			
Yes	72.0% (157)	21.6% (47)	6.4% (14)
No	72.2% (741)	19.5% (200)	8.3% (85)
Mental Illness			
Yes	71.6% (689)	20.6% (198)	7.9% (76)
No	74.4% (209)	17.4% (49)	8.2% (23)
Developmental PHPA^c Score			
0	72.7% (483)	20.6% (125)	6.7% (49)
1 to 10	62.0% (348)	21.3% (99)	16.7% (32)
>10	72.2% (67)	19.9% (23)	8.0% (18)
Family Interaction PHPA Score			
0	79.6% (214)	16.7% (45)	3.7% (10)
1 to 10	71.8% (465)	20.8% (135)	7.4% (48)
>10	67.0% (219)	20.5% (67)	12.5% (41)
Area-Level Residential Instability Quintile			
1 st	74.4% (142)	20.9% (40)	4.7% (9)
2 nd	70.9% (168)	19.4% (46)	9.7% (23)
3 rd	76.0% (171)	15.4% (38)	7.1% (16)
4 th	74.0% (216)	16.8% (49)	9.3% (27)
5 th	67.2% (201)	24.8% (74)	8.0% (24)
Area-Level Economic Dependency Quintile			
1 st	69.6% (188)	22.2% (60)	8.2% (22)
2 nd	71.4% (210)	18.7% (55)	9.9% (29)
3 rd	75.1% (172)	17.5% (40)	7.4% (17)
4 th	75.4% (199)	18.9% (50)	5.7% (15)
5 th	69.0% (129)	22.5% (42)	8.6% (16)
Area-Level Ethno-cultural Composition Quintile			
1 st	74.1% (177)	19.3% (46)	6.7% (16)
2 nd	72.0% (144)	18.5% (37)	9.5% (19)
3 rd	75.9% (186)	17.6% (43)	6.5% (16)
4 th	73.0% (184)	20.2% (51)	6.8% (17)
5 th	67.2% (207)	22.7% (70)	10.1% (31)
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Baseline Characteristic, % (n)	Appropriate Development (n=898)	Potential Developmental Concern (n=247)	Developmental Concern (n=99)
Area-Level Situational Vulnerability Quintile			
1 st	72.7% (210)	19.4% (56)	8.0% (23)
2 nd	68.6% (181)	23.1% (61)	8.3% (22)
3 rd	72.2% (158)	18.3% (40)	9.6% (21)
4 th	77.2% (190)	17.9% (44)	4.9% (12)
5 th	70.4% (159)	20.4% (46)	9.3% (21)

- a. Prenatal Health Concern includes gestational diabetes, gestational hypertension, a caesarean section, or a poor pregnancy outcome before the baby's birth.
- b. Chronic Disease includes diabetes, hypertension, or asthma before the baby's birth.
- c. PPHA: Public Health Priority Assessment

Table 8: Child development at age 18 months, as measured using the Ages & Stages Questionnaire, in relation to postnatal program duration among HFHB postnatal program participants

Outcome, % (n)	0-6 Mos (n=98)	>6-12 Mos (n=114)	>12-18 Mos (n=94)	>18 Mos (n=392)
Developmental Concern	10.2% (10)	7.0% (8)	9.6% (9)	10.2% (40)
Potential Developmental Concern	19.4% (19)	17.5% (20)	19.2% (18)	19.6% (77)
Appropriate Development	70.4% (69)	75.4% (86)	71.3% (67)	70.2% (275)

Child Development at Age 4-5 Years

Table 9: Regression model results evaluating impact of HFHB postnatal program participation on child development at age 4-5 years, measured using the preschool Early Years Evaluation Direct Assessment (EYE-DA)

EYE-DA Outcome	Non-Participants (n=3608)	HFHB Postnatal Participants (n=764)	PS-Matched Sample (n=921)	Unadjusted OR ^b (95% CI ^b)	PS-Adjusted ^b OR (95% CI)	PS-Matched ^b OR (95% CI)
Significant Difficulty	27.0% (973)	40.6% (310)	35.9% (331)	1.85 (1.57 to 2.17)	1.09 (0.89 to 1.33)	1.03 (0.83 to 1.27)
Some Difficulty	20.9% (754)	20.6% (157)	20.4% (188)	1.71 ^a (1.46 to 2.01)	1.03 ^a (0.85 to 1.25)	1.01 ^a (0.83 to 1.25)
Appropriate Development	52.1% (1881)	38.9% (297)	43.7% (402)	Reference	Reference	Reference

a. Modelled as yellow or any red, compared to all green

b. CI: confidence interval; OR: odds ratio; PS: propensity score; PS-adjusted: PS included as covariate; PS-matched: each HFHB postnatal program participant was matched to 1 or 2 non-participants

Table 10: Child development at age 4-5 years, as measured using the Early Years Evaluation Direct Assessment, in relation to baseline characteristics among the HFHB postnatal program participants and PS-matched sample combined

Outcome, % (n)	Appropriate Development (n=699)	Some Difficulty (n=345)	Significant Difficulty (n=641)
Social Assistance			
Yes	32.4% (139)	21.5% (92)	46.2% (198)
No	44.6% (560)	20.1% (253)	35.3% (443)
Marital Status			
Married	49.3% (284)	17.5% (101)	33.2% (191)
Single	37.3% (374)	21.9% (220)	40.8% (409)
Other	38.7% (41)	22.6% (24)	38.7% (41)
Immigrant			
Yes	46.2% (49)	11.3% (12)	42.5% (45)
No	41.2% (650)	21.1% (333)	37.8% (596)
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Outcome, % (n)	Appropriate Development (n=699)	Some Difficulty (n=345)	Significant Difficulty (n=641)
Diabetes or Hypertension			
Yes	32.2% (18)	23.2% (13)	44.6% (25)
No	41.8% (681)	20.4% (332)	37.8% (616)
Asthma			
Yes	39.0% (96)	21.1% (52)	39.8% (98)
No	41.9% (603)	20.4% (293)	37.7% (543)
Mental Illness			
Yes	40.9% (543)	20.8% (277)	38.3% (509)
No	43.8% (156)	19.1% (68)	37.1% (132)
Prenatal Health Concern^a			
Yes	44.4% (28)	12.7% (8)	42.9% (27)
No	41.4% (671)	20.8% (337)	37.9% (614)
Developmental PHPA^b Score			
0	44.6% (381)	20.5% (175)	34.9% (298)
1 to 10	39.7% (268)	21.2% (143)	39.1% (264)
>10	32.1% (50)	17.3% (27)	50.6% (79)
Family Interaction PHPA Score			
0	46.6% (157)	20.2% (68)	33.2% (112)
1 to 10	44.5% (405)	20.8% (189)	34.8% (317)
>10	31.4% (137)	20.1% (88)	48.5% (212)
Area-Level Residential Instability Quintile			
1 st	48.1% (124)	19.4% (50)	32.6% (84)
2 nd	43.9% (137)	20.2% (63)	35.9% (112)
3 rd	37.5% (115)	21.8% (67)	40.7% (125)
4 th	41.1% (152)	21.4% (79)	37.6% (139)
5 th	39.0% (171)	19.6% (86)	41.3% (181)
Area-Level Economic Dependency Quintile			
1 st	45.2% (191)	18.4% (78)	36.4% (154)
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Outcome, % (n)	Appropriate Development (n=699)	Some Difficulty (n=345)	Significant Difficulty (n=641)
2 nd	41.4% (173)	21.1% (88)	37.6% (157)
3 rd	42.2% (133)	19.7% (62)	38.1% (120)
4 th	41.7% (138)	20.2% (67)	38.1% (126)
5 th	32.3% (64)	25.3% (50)	42.4% (84)
Area-Level Ethno-cultural Composition Quintile			
1 st	40.2% (103)	21.9% (56)	37.9% (97)
2 nd	41.8% (120)	20.9% (60)	37.3% (107)
3 rd	40.1% (134)	19.5% (65)	40.4% (135)
4 th	43.1% (157)	19.0% (69)	37.9% (138)
5 th	41.7% (185)	21.4% (95)	36.9% (164)
Area-Level Situational Vulnerability Quintile			
1 st	49.3% (197)	20.3% (81)	30.5% (122)
2 nd	43.3% (165)	20.5% (78)	36.2% (138)
3 rd	39.8% (119)	19.7% (59)	40.5% (121)
4 th	37.6% (137)	19.2% (70)	43.1% (157)
5 th	33.6% (81)	23.7% (57)	42.7% (103)

- a. Prenatal Health Concern included gestational diabetes, gestational hypertension, a caesarean section, or a poor pregnancy outcome before the baby's birth.
- b. PPHA: Public Health Priority Assessment

Table 11: Child developmental outcomes at age 4-5 years, as measured using the Early Years Evaluation Direct Assessment, in relation to postnatal program duration among HFHB postnatal program participants

Outcome, % (n)	0-6 Mos (n=171)	>6-12 Mos (n=193)	>12-18 Mos (n=121)	>18 Mos (n=279)
Significant Difficulty	39.8% (68)	39.9% (77)	33.9% (41)	44.4% (124)
Some Difficulty	20.5% (35)	25.4% (49)	21.5% (26)	16.9% (47)
Appropriate Development	39.8% (68)	34.7% (67)	44.6% (54)	38.7% (108)

Table 12: Early Years Evaluation Direct Assessment (EYE-DA) outcome in relation to completion of the Ages and Stages Questionnaire (ASQ) among study cohort

EYE-DA Outcome, % (n)	Completed ASQ (n= 2287)	Did Not Complete ASQ (n=2085)
Significant Difficulty	26.9% (615)	32.0% (668)
Some Difficulty	20.4% (467)	21.3% (444)
Appropriate Development	52.7% (1205)	46.7% (973)

Table 13: Early Years Evaluation Direct Assessment (EYE-DA) outcome in relation to completion of the Ages & Stages Questionnaire (ASQ) among the HFHB postnatal program participants and PS-matched sample combined

EYE-DA Outcome, % (n)	Completed ASQ (n=874)	Did Not Complete ASQ (n=811)
Significant Difficulty	35.8% (313)	40.4% (328)
Some Difficulty	20.0% (175)	21.0% (170)
Appropriate Development	44.2% (386)	38.6% (313)

Completion Rates

Table 14: Completion rates for outcomes among study cohort

Assessment	Total Sample (n=6096)	Non- Participants (n=4885)	HFHB Postnatal Participants (n=1211)	PS-Matched Sample (n=1366)
Breastfeeding Outcomes at Age 18 Months, % (n)				
Completed	48.6% (2960)	50.2% (2253)	58.4% (707)	38.6% (527)
Not Completed	51.4% (3136)	49.8% (2632)	41.6% (504)	61.4% (839)
Ages & Stages Questionnaire at Age 18 Months, % (n)				
Completed	49.0% (2987)	46.9% (2289)	57.6% (698)	40.0% (546)
Not Completed	51.0% (3109)	53.1% (2596)	42.4% (513)	60.0% (820)
Early Years Evaluation Direct Assessment at Age 4-5 Years, % (n)				
Completed	71.7% (4372)	73.9% (3608)	63.1% (764)	67.4% (921)
Not Completed	28.3% (1724)	26.1% (1277)	36.9% (447)	32.6% (445)

Table 15: Completion rates for outcome data in relation to postnatal program duration among HFHB postnatal program participants

Developmental Assessment	0-6 Mos	>6-12 Mos	>12-18 Mos	>18 Mos
Ages & Stages Questionnaire at Age 18 Months, % (n)				
Completed	34.2% (98)	37.9% (114)	49.2% (94)	90.7% (392)
Not Completed	65.9% (189)	62.1% (187)	50.8% (97)	9.3% (40)
Early Years Evaluation Direct Assessment at Age 4-5 Years, % (n)				
Completed	59.6% (171)	64.1% (193)	63.4% (121)	64.6% (279)
Not Completed	40.4% (116)	35.9% (108)	36.7% (70)	35.4% (153)

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