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Breaking the Cycle of Deprivation:
An Experimental Evaluation of an Early Childhood Intervention

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Abstract

Deprivation early in life has multiple long term consequences for both the individual and society. An increasing body of evidence finds that targeted, early interventions aimed at at-risk children and their families can reduce socioeconomic inequalities in children's skills and capabilities. This paper describes a randomised control trial (RCT) evaluation of a five-year preventative programme which aims to improve the school readiness skills of socioeconomically disadvantaged children. The *Preparing for Life* (*PFL*) programme is one of the first studies in Ireland to use random assignment to experimentally modify the environment of high risk families and track its impact over time. This paper describes the design and motivation for the study, the randomisation procedure adopted and the baseline data collected. Using Monte Carlo permutation testing, it finds that the randomisation procedure was successful as there are no systematic differences between the treatment and control groups at baseline. This indicates that future analysis of treatment effects over the course of the five year evaluation can be causally attributed to the programme and used to determine the impact of *Preparing for Life* on children's school readiness skills.

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1. INTRODUCTION

Deprivation early in life has multiple long term consequences for both the individual and society in general. The consequences of being raised in disadvantaged circumstances are significant, as socioeconomic inequalities in children's health and development emerge early and increase over time (Najman *et al.*, 2004; Shonoff and Philipps, 2000). Growing up in poverty can affect a child's early skill development leading to greater vulnerability at school entry (Duncan and Brooks-Gunn, 1997), poorer cognitive skills (Stipek and Ryan, 1997), less developed social skills (Janus and Duku, 2007), as well as more emotional and behavioural problems (McLoyd, 1998). In addition, such early developmental difficulties can also affect major long term public and social policy issues such as academic achievement (Raver, 2003), employment (Rouse, Brooks-Gunn and McLanahan, 2005), teenage pregnancy, and psychological well-being (Brooks-Gunn, 2003).

Such deprivation is intergenerational in nature and is difficult to eradicate. Remediation policies are the most common method for addressing social inequalities, yet evidence suggests that they are both costly and less effective than preventative policies (Carneiro and Heckman, 2003). An increasing body of evidence finds that targeted, early interventions aimed at at-risk children and their families can reduce socioeconomic disparities in children's capabilities (see Kahn and Moore, 2010 for a review). Yet this evidence is predominantly US based and there is a clear lack of research on the effects of early intervention in countries with different social and cultural contexts such as Ireland.

Investment in early intervention programmes is efficient from both biological and economic perspectives. Intervening early in life, when children are at their most receptive stage of development, has the potential to permanently alter their brain development and subsequent developmental trajectories (Halfon, Shulman, and Hochstein, 2001). Early intervention is also economically efficient. Research on US intervention programmes has

demonstrated high rates of return such that the individual and societal benefits accrued from intervening early typically outweigh the costs (Karoly, Kilburn, and Cannon, 2005; Reynolds *et al.* 2010). For example, the US Perry Preschool Programme resulted in higher levels of education, employment, and earnings, and lower rates of crime, teenage pregnancy and social welfare dependency, resulting in an estimated social rate of return of between 7-10% per annum (Heckman *et al.* 2010).

This paper describes a randomised control trial (RCT) evaluation of a preventative programme which aims to improve the life outcomes of socioeconomically disadvantaged children. The programme is operating in several disadvantaged communities of Dublin with above national average rates of unemployment, early school leavers, lone parent households and social housing (Census, 2006).[1] The *Preparing for Life* (PFL) programme, which began in 2008, works with families from pregnancy until school entry in order to promote positive child development through improved parental behaviour and social support. This paper presents data from the baseline evaluation which was conducted before the intervention began. This study is one of the first in Ireland to use random assignment to experimentally modify the environment of high risk families and track its impact over time.

Section 2 sets out the design and motivation underlying the development of the *PFL* programme. Specifically, it describes the level of school readiness skills in the catchment area prior to the intervention, the theoretical foundations of the intervention, and a detailed account of the *PFL* treatment. Section 3 presents the evaluation strategy which includes an experimental longitudinal design and an implementation analysis. Section 4 examines the recruitment and randomisation procedures used. Section 5 describes the permutation-based statistical methods that are used to test for the effectiveness of the randomisation procedure. Section 6 presents the results of permutation tests comparing the high and low treatment

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[1] For confidentiality reasons the communities are not named.

groups and the aggregate *PFL* and comparison groups at baseline. This section also describes the *PFL* cohort in detail. Finally, section 7 concludes and sets out the future evaluation strategy of the programme.

2. PROGRAMME DESIGN

Programme Need

The *Preparing for Life* (*PFL)* programme aims to improve levels of school readiness by intervening during pregnancy and working with families until the children start school. *PFL* is a community-based programme developed by the Northside Partnership in Dublin over a five year period between 2003 and 2008. It was developed in response to evidence that children from these communities were lagging behind their peers in terms of both cognitive and non-cognitive skills at school entry. A representative survey assessing the school readiness skills of children aged four to five years old attending the primary schools in the *PFL* catchment areas was conducted in 2008.[2] School readiness was measured using teacher and parent reports on the Short Early Development Instrument (S-EDI; Janus, Duku, and Stat, 2005). The S-EDI is composed of 48 core items and provides scores across five domains of school readiness (physical health and well-being, social competence, emotional maturity, language and cognitive development, and communication and general knowledge). Figure 1 indicates that teachers rated children in the *PFL* catchment area as displaying significantly lower levels of school readiness than the norm[3], while parents rated children as displaying higher levels of school readiness than the norm. Specifically, parents rated children as displaying higher levels of physical health and well-being, social competence, emotional maturity, and communication and general knowledge, while teachers' ratings were

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[2] This data was collected by the author and the *PFL* evaluation team at the UCD Geary Institute. For more information on this study please refer to Doyle and McNamara (2011).
[3] The S-EDI normative data is based on a representative sample Canadian that is similar in age to the sample in the PFL catchment area. There is no normative S-EDI data available for Ireland.

significantly lower (Doyle, McEntee, and McNamara, 2012). In addition, the school readiness capabilities of children living in this area appear to be consistently low over time as the teachers indicated that less than 50% of children entering school in the *PFL* catchment area were *definitely ready* for school in 2004 (Murphy et al., 2004) and again in 2009 and 2010 (Doyle and McNamara, 2011).

Figure 1

Pre-Intervention School Readiness Skills of Children in the PFL Catchment Area
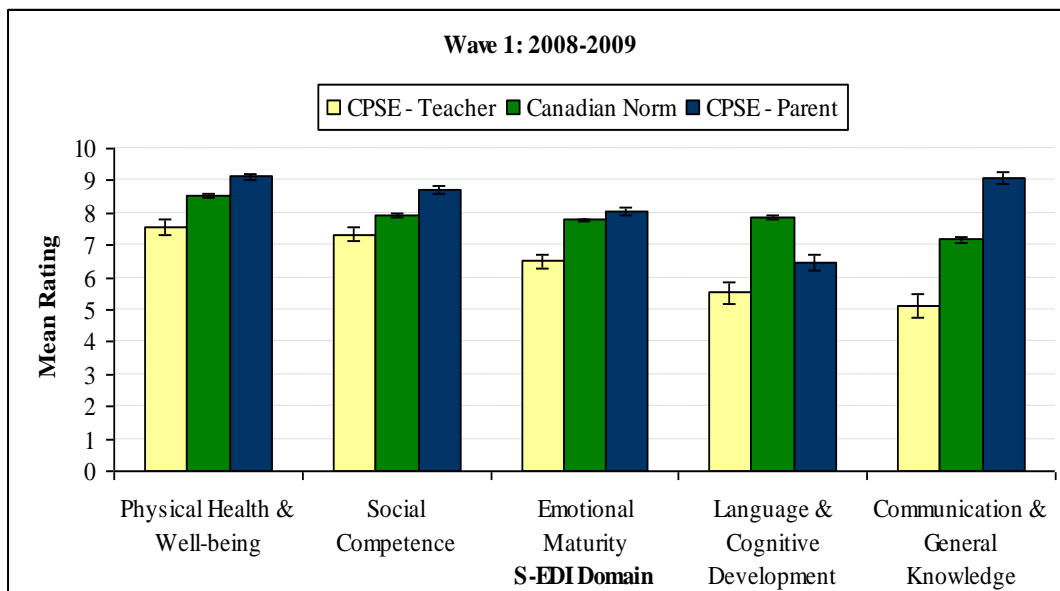
Note: CPSE, which represents *Children's Profile at School Entry*, is the assessment of junior infant children's school readiness skills conducted annually in the *PFL* catchment areas.

Theoretical Foundation of the Programme

The development of *PFL* was a bottom-up initiative involving 28 local agencies and community groups who worked collaboratively to develop a programme that was both tailored to meet the needs of the local community and was grounded in empirical evidence.[4] The programme was developed using a theory of change and logic model methodology,

[4] For more information on the development of the *PFL* programme please refer to the report '*A Process Evaluation on the Development of the Preparing for Life Programme*' (*Preparing for Life* Evaluation Team, 2009) which is based on an analysis of semi-structured interviews with fifteen key individuals involved in the development of the programme.

which resulted in a *PFL* programme manual (*Preparing for Life* & The Northside Partnership, 2008). *PFL* is grounded in several psychological theories of development including the theory of human attachment (Bowlby, 1969), socio-ecological theory of development (Bronfenbrenner, 1979), and social-learning theory (Bandura, 1977). These theories indicate that providing support to parents improves parent and child outcomes while empowering families and local communities.

The logic model is focused on how and why the *Preparing for Life* treatment may alter the developmental trajectories of children participating in the programme. It hypothesizes that all children will be better prepared to start school if they and their families receive enhanced pre-school and childcare services and agencies better target and integrate their services. Specifically, the one-to-one mentoring component of the *PFL* programme will promote change in parents' knowledge, attitudes and well-being, ultimately influencing the child's development. For example, it is hypothesised that parents involved in the programme will learn more about healthy child development and how to nurture it, they will develop higher aspirations for their children, they will have better physical health themselves and their self-confidence will increase (*Preparing for Life* & The Northside Partnership, 2008). These factors will have a positive impact on parental psychological well-being and morale, which in turn will contribute to increased enjoyment of parenting and the development of a more positive relationship and attachment style to their children.

Description of the PFL Intervention

Preparing for Life is a multi-dimensional programme which provides a range of supports to participating families from pregnancy until school entry. It is a manualised programme which shares some characteristics with other international early childhood programmes such as the US-based Nurse Family Partnership programme (Olds et al. 1999). However it provides a

more intense treatment, in terms of its duration and intensity, compared to many other intervention programmes. The purpose of the programme is to improve the documented low levels of school readiness by assisting parents in developing skills to help prepare their children for school. The programme operates under a holistic definition of school readiness and targets a range of child outcomes including cognitive development, physical health and motor skills, socio-emotional development, behavioural skills, language development and emergent literacy.

On recruitment during pregnancy, participants were randomly assigned to either a low treatment group or a high treatment group. Both the high and low treatment groups receive €100 worth of developmental toys annually and facilitated access to one year of high quality preschool.[5] Both groups are also encouraged to attend public health workshops on Stress Control and Healthy Food Made Easy which are available in the community.

The low treatment group have access to a *PFL* information support worker who can help them connect to additional community services if needed. The information worker meets with families before birth and contacts the families at various intervals, such as when sending developmental packs, and when the child is due to begin crèche. However, the information worker does not provide the participants in the low treatment group with any information related to parenting or child development.

The high treatment group receive two additional supports that are not available to the low treatment group. First, participants in the high treatment group receive a home-visiting mentoring support service. Home visiting programmes are a common form of early intervention which provide parents with information, emotional support, access to other community services, and direct instruction on parenting practices (Howard & Brooks-Gunn,

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[5] This support was developed prior to the new Government scheme which provides every three year old child in Ireland with access to a free preschool place for one year. The *PFL* programme has reserved a preschool place for all *PFL* children in the local childcare centres and has been working with the local preschools to improve their quality using the Siolta framework.

2009). Each family in the high treatment group has an assigned mentor who visits the home each week for between 30 minutes and two hours starting during pregnancy and continuing until the child starts school. The home visits are provided by trained *PFL* mentors with a cross section of professional backgrounds including education, social care, youth studies, psychology, and early childcare and education. The aim of the home visits is to support and help the parents with key parenting issues using a set of *PFL* developed Tip Sheets. The Tip Sheets are designed to be delivered based on the age of the child and the needs of the family, however, the participants must have received the full set of Tip Sheets by the end of the programme.

While a number of studies have found home visiting programmes to generate significant and positive short and long term outcomes (Olds et al., 1999; Sweet and Appelbaum, 2004), a recent review of home visiting programmes evaluated by experimental design found that only half of these programmes had a positive impact on at least one child outcome (Kahn and Moore, 2010). The most effective programmes were high intensity programmes that lasted for more than a year, had an average of four or more home visits per month and utilised therapists/social workers. Thus, the *PFL* programme which is operating for five years, offering weekly home visits, and is delivered by trained professionals meets these criteria.

Secondly, participants in the high treatment group also participate in group parent training using the Triple P Positive Parenting Programme (Sanders, Markie-Dadds, and Turner, 2003). Triple P aims to improve positive parenting through the use of videos, vignettes, role play, and tip sheets in a group-based setting for eight consecutive weeks. The group-based component of the Triple P programme has been subject to multiple rigorous evaluations which have demonstrated positive effects for both parents and children (Sanders,

Markie-Dadds, Tully, and Bor, 2000). The Triple P programme is delivered to participants in the high treatment group when their children are at least two-years old.

Finally, both the high and low treatment groups receive a framed professional photograph of their child as well as programme newsletters and special occasion cards. Figure 1 illustrates the design of the *PFL* programme and evaluation.

Figure 1

Illustration of the PFL Programme Experimental Design and Evaluation
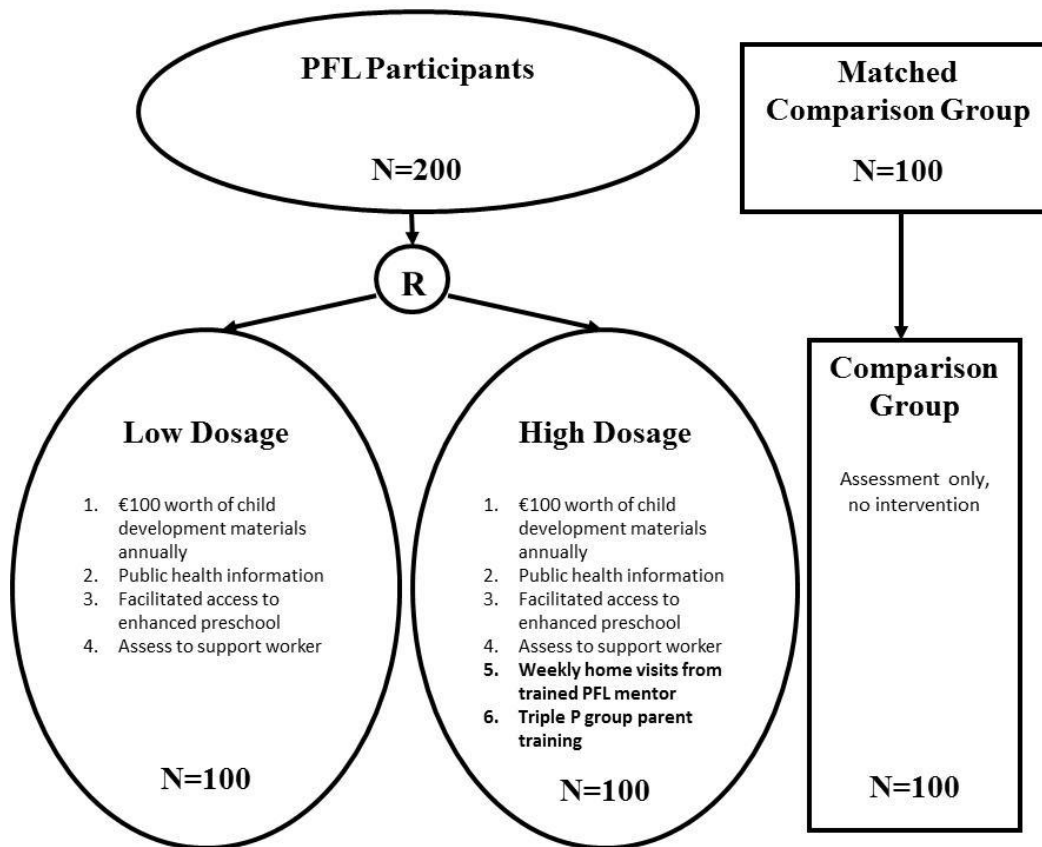
3. EVALUATION DESIGN

Experimental and Quasi-Experimental Design

The programme is being evaluated using a mixed methods approach, incorporating a longitudinal experimental design and implementation analysis. The experimental component involves the random allocation of participants from the *PFL* communities to either the low or high treatment group described above for the duration of the programme. As random assignment was used any observed differences between the high and low dosage groups at each evaluation point can be causally attributed to the intervention itself. Randomised control trials are the gold standard methodology for evaluating the effectiveness of policies or interventions as they remove selection bias and provide a more reliable assessment of treatment effects (Solomon, Cavanaugh, and Draine, 2009).

A key issue in experimental design is maintaining internal validity. One of the main threats to internal validity is contamination which occurs when individuals assigned to the control group either actively or passively receive all or part of the services designed for the treatment group (Cook and Campbell, 1979). As the potential for contamination between the two *PFL* treatment groups is high as participants were selected from the same community, an additional comparison group was recruited from a socio-demographically similar community which was not geographically close to the treatment communities. Thus, the *PFL* treatment groups also are being compared to a 'services as usual' comparison group, who do not receive the *PFL* programme.

This comparison group was selected using hierarchal cluster analysis to identify communities that rank closely to the *PFL* communities in terms of standard socioeconomic

demographics such as education, employment, and social housing.[6] Specifically, small area population statistics (SAPS) from Census 2006 were used to calculate the Euclidean pairwise distance between all 322 communities in Dublin in terms of their closeness to the *PFL* community. Dissimilarity matrices showing the degree of similarity between communities were constructed, allowing comparisons of results across variable inputs. Although the selected comparison community was similar to the *PFL* catchment areas, it was not the closest ranking community. Several communities were more similar to the *PFL* communities, but they were already experiencing some form of early childhood intervention. Therefore, in order to identify the impact of *PFL* compared to a service as usual comparison group, the selected Dublin community does not receive an early childhood intervention, yet is socio-demographically similar to the *PFL* community.

Longitudinal Data Collection

The impact evaluation collects data from all three groups (high treatment, low treatment, comparison group) at baseline during pregnancy (t0), and when the child is six months (t1), 12 months (t2), 18 months (t3), 24 months (t4), three years (t5), and four years old (t6). A comprehensive set of data are collected at each point including the children's physical health and motor skills, social and emotional development, behavioural development, and cognitive, learning, literacy and language development. Information is also elicited on extensive family socio-demographics and on the mother's pregnancy behaviours, physical and psychological health, personality, time preferences, and parenting skills. Each interview includes standardised instruments, individual questions and direct assessment. In addition, maternal cognition is assessed at one time point, usually between t0 and t1, using the Wechsler Abbreviated Scale of Intelligence. Although the mother is the primary informant, information

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[6] The full set of variable include the inhabitants' age; marital status; country of birth; ethnicity (incl. travellers); size of family unit; composition of family units (i.e. lone parents); social housing; employment status; occupation; socio-economic group; highest level of education; age left education; and housing type.

is also obtained from fathers, the *PFL* child, and other independent data sources. This paper reports data from maternal responses obtained through face-to-face structured interviews at t0.

Implementation Analysis

Parallel to the impact evaluation, an implementation analysis is being conducted using a multi-sequenced design, integrating focus group methods with *PFL* participants and semi-structured interviews with programme staff to assess programme implementation and fidelity. In addition, implementation data recorded by programme staff concerning the number and duration of home visits are also tracked on an on-going basis to measure attrition and programme dosage. The collection of attrition data allows us to test whether the original equivalence of the treatment groups is maintained at each evaluation point. The dosage data allows us to conduct a dosage analysis to determine how variation in treatment is associated with variation in programme impact.

4. RECRUITMENT & RANDOMISATION

The inclusion criteria for the *PFL* programme are based on geographical residence and pregnancy status, and include both primiparous (first-time) and non-primiparous (non first-time) women. According to Census data from 2006, the *PFL* catchment area is composed of 15,384 inhabitants, 7% of whom were born outside Ireland, 42% were living in social housing, 12% were unemployed, and 7% had completed a third level education.

Recruitment

Recruitment into the study occurred through one of two sources: 1) in the maternity hospital at the first booking visit or 2) self-referrals in the community. Recruitment began in January,

2008 and finished in September, 2010. The recruitment process involved substantial interactions and collaboration with the maternity hospitals in order to identify eligible women in a confidential manner.[7] In total, 233 women from the *PFL* catchment area were recruited into the study. A unconditional probability randomisation procedure resulted in 118 participants being randomly assigned to the low treatment group and 115 being randomly assigned to the high treatment group. In addition, 99 women from the comparison community were recruited. On average, *PFL* participants were 21.5 ($M_{Low} = 21.3$, $SD_{Low} = 7.0$; $M_{High} = 21.6$, $SD_{High} = 7.9$) weeks pregnant when completing the baseline interview and comparison community participants were, on average, 25.2 ($SD = 10.4$) weeks pregnant.[8] The average week of pregnancy upon joining the programme does not differ between the low and high *PFL* treatment groups, but the comparison community is significantly farther along in pregnancy than the aggregate *PFL* cohort ($T = 4.3$, $p<.001$).

According to public health nurse records, the population-based recruitment rate for the *PFL* cohort, *based on all live births during the recruitment phase*, was 52%. Twenty-two per cent of pregnant women in the area were not identified in the recruitment phase and a further 26% were approached and not interested in participating.[9] The sample-based recruitment rate for the *PFL* cohort, *based on all approached eligible participants during the recruitment phase*, was 67%. The sample-based recruitment rate for the comparison community was 36%.

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[7] The hospital administrative staff send the UCD evaluation team a weekly list stating the number of women from the *PFL* catchment area who were scheduled to have their first booking visit at the hospital the following week. The list included the time and date of the visit, but for confidentiality reasons no names or contact information was included. The hospital staff also flagged the files of these eligible women on their computer system. By doing this, an alert appeared on the computer screen when the eligible women were booked into the clinic in the Outpatient Department (OPD). When this alert appeared, the OPD staff gave the women a *PFL* flier explaining the programme and introduced them to the *PFL* recruiter who was present in the waiting room of the clinic. The recruiter then briefly explained the programme to the eligible women and asked for their contact details. The initial plan was to fully recruit participants in the hospitals, however, due to time and space restrictions, as well as confidentiality concerns, it was realised that this was not be possible. Instead, if the women were interested, the recruiter took contact details and ring her later that day to set up a recruitment appointment to take place in the village centre.

[8] Baseline interviews were conducted, on average, 1.4 weeks after recruitment for the *PFL* cohort. The baseline interview was conducted on the same day as recruitment for the comparison community.

[9] A survey of non-joiners will be completed by the end of the evaluation period.

The *PFL* community recruitment rate (88%) was higher than the *PFL* hospital recruitment rate (51%). As community recruitment involved women initiating contact with the *PFL* programme in order to learn more about the programme and/or directly join the programme, it is unsurprising that the community recruitment rate is higher than the hospital recruitment rate.[10]

Randomisation

PFL participants were randomised after informed consent was obtained. To ensure randomisation was not compromised an unconditional probability computerised randomisation procedure was used whereby the participant pressed a key on a computer which randomly allocated her treatment group assignment. Once assignment was completed, an automatic email was generated which included the participant's unique ID number and assignment condition. This email was automatically sent to the *PFL* programme manager and the evaluation manager.[11] This method was used to ensure that the recruiter had no influence on the treatment assignment as there is evidence that the experimental design in some of the most influential early childhood interventions from the US, such as the Perry Preschool Program, were compromised (Heckman et al., 2010). Thus if any attempts to reassign participants from one group to another group, by either directly changing the database or repeating the randomisation procedure, a second email would be generated to automatically highlight this intentional subversion.

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[10] Of the *PFL* participants recruited from the community, 25% indicated they were referred to the programme from a friend or family member already taking part in the programme. Twelve percent indicated they heard about the programme through a *PFL* affiliate or informational material, a further 12% were recommended by a medical professional, and an additional 12% were referred by a local service provider. Nine percent heard about the programme from educational professionals in the area and 8% were referred by a friend or family member not taking part in the programme. Finally, 22% of community referrals did not indicate that they were referred to the *PFL* programme by anyone.

[11] The author of this paper.

5. STATISTICAL METHODS

In addition to assessing the effectiveness of the *PFL* programme, the evaluation also applies several innovative statistical methods to advance the field of experimental evaluation. For example, classical hypothesis tests, such as the *t*-test and *F*-test, which are typically used to estimate treatment effects, are unreliable when the sample size is small and the data are not normally distributed (Ludbrook and Dudley, 1998; Marozzi, 2002). Given the relatively small sample of the *PFL* study, and the non-normality of many outcome measures, traditional techniques are not appropriate. An alternative to these methods, which has not been extensively used in the evaluation literature, is permutation based inference methods. A permutation test gives accurate *p*-values even when the sample sizes are small and sampling distribution is skewed as they do not rely on parametric assumptions (Marozzi, 2002).

A permutation test is a method whereby the outcome of interest is tested for significance by comparing the original sample to multiple, random permutations of the data. In essence, permutation tests involve testing a null hypothesis (i.e., the hypothesis that there are no differences between the groups at baseline) using permutations of the data. Taking permutations of the data means randomly shuffling the data so that treatment assignment of some participants is switched between the treatment and control group. If the null hypothesis is true and there are no real differences in the outcomes of the treatment and control group at baseline, then taking permutations of the data does not change the distribution of either outcome. Thus, we can determine whether the groups are equivalent at baseline by testing the equality of distributions between the treatment and control outcomes, whereby the joint distribution of outcomes and treatment is invariant to permutation of its elements.

In practice, the permutation testing procedure compares a test statistic computed on the original (pre-permutation) data with a distribution of test statistics computed on re-samplings of that data. First, the relationship between measures is observed and a test statistic

is calculated. Then, the data are shuffled multiple times (i.e., 20,000) to examine whether the observed relationship is likely to occur by chance. The *p*-value for a permutation test is computed as the fraction of re-sampled data which yield a test statistic greater (or less, depending on the direction of the test) than that yielded by the original data. If the fraction is small, we know that the original statistic is an unlikely outcome. This method was used to analyse data for the evaluation of the Perry Preschool Program by Heckman et al. (2010).

We apply Monte Carlo two-sided permutation tests based on 20,000 replications in this paper to test for baseline differences on multiple individual and family characteristics between the two *PFL* treatment groups (*High* and *Low*) and the *PFL* group and the comparison community group.

6. BASELINE RESULTS

In total, 233 *PFL* participants were randomised into either the high or low treatment group (n_{Low} = 118; n_{High} = 115). Twenty one participants (n_{Low} = 14; n_{High} = 7) disengaged post recruitment, prior to completing a baseline interview, two participants (n_{Low} = 1; n_{High} = 1) had a miscarriage before completing the baseline interview, and five *PFL* participants (n_{Low} = 2; n_{High} = 3) were unresponsive during the post recruitment period until after their child was born and thus no baseline data are available for these participants. Therefore, baseline data are available for 205 *PFL* participants, (n_{Low} = 101; n_{High} = 104) and 99 comparison community participants.[12]

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[12] An analysis of the socio-demographic characteristics of those who disengaged from the programme before treatment was conducted for participants who provided such data i.e. 12 of the 25 disengaged participants. There were no significant differences between participants who remained in the programme and those who disengaged before the programme began regarding maternal age, age left education, employment status, financial status and support from family and friends. There was one significant difference - individuals who completed a baseline assessment indicated they received significantly more support from friends than those who dropped out of the programme before completing this baseline interview. While this analysis suggests that the disengaged participants do not differ in any systematic way those who remained in the programme, it is important to note that the sample size used in this analysis is small.

Baseline Measures

In total, 123 measures were assessed across five domains during the baseline assessment. Domain one focuses on parental socio-demographics and includes 33 measures on personal characteristics, parental education and employment status, household composition, and household material deprivation. Domain two focuses on maternal well-being and includes 24 measures on previous indications of postnatal depression and measures of self-esteem, self-efficacy, maternal attachment style, and personality. Domain three focuses on maternal health and pregnancy and includes 35 measures on self-reported maternal health across the lifespan and information related to the pregnancy. Domain four focuses on parenting and includes 13 measures on maternal thoughts about parenting, and intentions for the newborn baby. Finally, domain five focuses on social support and service use and includes 18 measures on social connectedness and maternal use of local services in the *PFL* communities. A description of these instruments may be found in the Appendix.

Description of the PFL Cohort

Tables 1, 2 and 3 present selected characteristics of the *PFL* sample at baseline. Table 1 reports on selected family socio-demographics for the high and low *PFL* treatment groups. On average, the sample is about 25 years old upon joining the programme and half the sample are pregnant with their first child. The educational level of mothers is relatively low, with a very small proportion of mothers attaining a primary degree. Unemployment for both mothers and fathers in the sample is high and the annual income for mothers who are working is below the average industrial wage. The level of social disadvantage, as indicated by the proportion residing in social housing and the proportion in possession of a medical card, is also high.

Table 1

Permutation Results Comparing Baseline Differences in Selected Family Socio-demographics

Variable	N (n_LOW/ n_HIGH)	M_{LOW} (SD)	M_{HIGH} (SD)	$M_{LOW} - M_{HIGH}$	p	Effect Size (d)
	Low Treatment – High Treatment					
Mother's Age	205 (101/104)	25.30 (5.99)	25.46 (5.85)	-0.16	ns	.03
First-time Mother	205 (101/104)	0.50 (0.50)	0.54 (0.50)	- 0.04	ns	.09
Mother Married	205 (101/104)	0.18 (0.38)	0.14 (0.35)	0.04	ns	.09
Mother with Junior Certificate Qualification or Lower	205 (101/104)	0.40 (0.49)	0.34 (0.47)	0.06	ns	.12
Mother with Primary Degree	205 (101/104)	0.03 (0.17)	0.03 (0.17)	0.00	ns	.01
Mother Unemployed	205 (101/104)	0.41 (0.49)	0.43 (0.50)	- 0.02	ns	.05
Annual Income of Working Mother (in Euros)	75 (38/37)	19,602 (8,093)	19,224 (9,851)	378	ns	.04
Father Unemployed	198 (97/101)	0.31 (0.46)	0.43 (0.50)	- 0.12	ns	.24
Residing in Social Housing	204 (101/103)	0.55 (0.50)	0.55 (0.50)	0.00	ns	.00
In Possession of a Medical Card	205 (101/104)	0.66 (0.47)	0.60 (0.49)	0.06	ns	.14

Note. 'N' indicates the sample size. 'M' and 'SD' indicate the mean and standard deviation respectively. The p values are based on two-tailed test from a permutation test with 20,000 replications. 'ns' indicates the variable is not statistically significant. 'd' indicates the Cohen's d effect size which represents the magnitude of the group difference.

Table 2 reports on maternal health and pregnancy for the high and low *PFL* treatment groups. It shows that while the physical health of the sample is generally high, mental health difficulties are a significant issue with one-quarter of the sample experiencing mental health problems as measured by the WHO-5 Well-Being Index (World Health Organisation, 1998). In terms of fertility decisions, one-third of the sample was using birth control practices when they became pregnant and one-third stated that the pregnancy was planned. Substance abuse during pregnancy is high, with almost half of the sample smoking during pregnancy and one-quarter drinking alcohol, however drug use is minimal.

Table 2

Permutation Results Comparing Baseline Differences in Selected Maternal Health & Pregnancy Measures

Variable	Low Treatment – High Treatment					
	N (n_{LOW}/n_{HIGH})	M_{LOW} (SD)	M_{HIGH} (SD)	$M_{LOW} - M_{HIGH}$	p	Effect Size (d)
Long Term Chronic Illness	205 (101/104)	0.08 (0.27)	0.11 (0.31)	- 0.03	ns	.09
Mental Health Condition	205 (101/104)	0.24 (0.43)	0.28 (0.45)	- 0.04	ns	.09
Low WHO-5 (mental well-being) Percentage Score	205 (101/104)	0.37 (0.48)	0.42 (0.50)	- 0.05	ns	.12
Used Birth Control Practices	203 (99/104)	0.33 (0.47)	0.33 (0.47)	0.00	ns	.01
Planned Pregnancy	203 (100/103)	0.30 (0.46)	0.29 (0.46)	0.01	ns	.02
Smoking During Pregnancy	205 (101/104)	0.48 (0.50)	0.51 (0.50)	- 0.03	ns	.07
Drinking During Pregnancy	205 (101/104)	0.27 (0.45)	0.25 (0.44)	0.02	ns	.04
Drug Use During Pregnancy	205 (101/104)	0.03 (0.17)	0.01 (0.10)	0.02	ns	.15

Note. 'N' indicates the sample size. 'M' and 'SD' indicate the mean and standard deviation respectively. The p values are based on two-tailed test from a permutation test with 20,000 replications. 'ns' indicates the variable is not statistically significant. 'd' indicates the Cohen's d effect size which represents the magnitude of the group difference.

Table 3 reports on parenting and well-being indicators for the high and low *PFL* treatment groups. Knowledge of infant development, as measured by the Knowledge of Infant Development Inventory (MacPhee, 1981), is relatively high, with higher scores on the measure representing a greater knowledge of infant development. There is a moderate to small risk of abuse and neglect as measured by the Adult Adolescent Parenting Inventory (Bavolek and Keene, 1999). However, only one-third of the sample state that they intend to breastfed the child. In terms of maternal self-efficacy, as measured by the Pearlin Self-Efficacy Scale (Pearlin and Schooler, 1978), the mothers are reporting relatively high self-efficacy scores, thus they state they have control over their lives and believe in their ability to

effectively parent their child. They also report relatively high levels of self-esteem as measured by the Rosenberg Self Esteem Scale (Rosenberg, 1965). The sample also report relatively high scores regarding the extent to which they consider distant versus immediate consequences of behaviours, as measured by the Consideration of Future Consequences Scale (Strathman et al., 1994). This measure is often used as a proxy for time preferences, thus it demonstrates that the sample have relatively low time preferences. Finally, on average, the sample has less than one household social and emotional risk factors at baseline. These factors include parenting, domestic violence, addiction, separation, mental health issues, bereavement, and abuse.

Table 3
Permutation Results Comparing Baseline Differences in Selected Parenting & Well-being Measures

	Low Treatment – High Treatment					
Variable	N (n_{LOW}/n_{HIGH})	M_{LOW} (*SD*)	M_{HIGH} (*SD*)	$M_{LOW} - M_{HIGH}$	p	Effect Size (*d*)
Knowledge of Infant Development Short Form (KIDI-SF) Score (0-100)	205 (101/104)	69.82 (8.18)	72.25 (7.60)	- 2.43	<.05	.31
Adult Adolescent Parenting Inventory (AAPI-2) Score (1-10)	205 (101/104)	5.12 (1.42)	5.25 (1.38)	- 0.13	ns	.09
Intention to Breastfeed Child	186 (92/94)	0.30 (0.46)	0.33 (0.47)	- 0.03	ns	.05
Pearlin Self Efficacy Score (0-4)	205 (101/104)	3.02 (0.52)	2.90 (0.52)	0.12	ns	.24
Rosenberg Self Esteem Score (0-18)	205 (101/104)	12.78 (2.86)	12.82 (2.69)	- 0.04	ns	.01
Consideration of Future Consequences (CFC) Scale (3-15)	205 (101/104)	10.33 (3.18)	9.50 (3.23)	0.83	ns	.26
Indicators of Household Social and Emotional Risk (0-9)	203 (99/104)	0.70 (1.18)	0.79 (1.08)	- 0.09	ns	.08

Note. 'N' indicates the sample size. 'M' and 'SD' indicate the mean and standard deviation respectively. The p values are based on two-tailed test from a permutation test with 20,000 replications. 'ns' indicates the variable is not statistically significant. 'd' indicates the Cohen's d effect size which represents the magnitude of the group difference.

Testing the Effectiveness of the Randomisation Procedure

While the tables above report the resulting p values from permutation tests examining baseline differences on selected variables of interest, they do not include all measures included in the analysis. Table 4 reports the proportion of measures on which there are no statistically significant differences between the low and high *PFL* treatment groups and the aggregate *PFL* cohort and the comparison community for all 123 baseline measures considered. A permutation test was conducted for each of the parental characteristics and behaviours measured and the resulting p value from a two-sided test indicates whether or not the null hypothesis is rejected (at the 5% level). If the randomisation procedure is successful, on average, the observed characteristics of the participants should be evenly distributed across the two treatment groups at baseline.

High v Low Treatment Groups

As demonstrated in Table 4, the low and high treatment *PFL* groups do not statistically differ on 97% of the measures analysed, thus indicating that the randomisation process was successful and suggesting that the low and high *PFL* treatment groups are similar before engaging in the *PFL* programme. This indicates that any differences in observed outcomes throughout the duration of the evaluation to be causally linked to the *PFL* programme.

There are no statistical differences on the parental socio-demographics domain, the maternal well-being domain, or the maternal health and pregnancy domain. There are three significant differences among the 13 measures included in the parenting domain. Parents in the high treatment group demonstrate greater knowledge of infant development than parents in the low treatment group ($p<.05$, $d = .31$). Specifically, mothers in the low treatment group score, on average, 69.82 on the Knowledge of Infant Development Inventory (KIDI-SF) compared to mothers in the high treatment group who score 72.25, whereby higher values (on

a scale of 0-100) are indicative of more knowledge of infant development. In addition, 60% of the low treatment group state they intend to use some form of childcare for the child they were pregnant with, compared to only 45% of the high treatment group ($p<.01$; $d = .31$). Mothers in the low treatment group also indicate they would utilise childcare for their child at a significantly younger age ($M_{low} = 6.31$ months; $M_{high} = 8.66$ months) than mothers in the high treatment group ($p<.05$; $d = .41$). Finally, there is one significant difference among the 18 measures analysed in the social support domain, such that mothers in high treatment group report using more community based services than those the low treatment group ($p<.05$, $d = .31$).

As the two groups differ on less than 5% of the measures analysed we are confident that the randomisation procedure was effective. The only difference that is cause for concern is regarding maternal knowledge of child development, thus this result is investigated in further detail. The sample is divided into two subsets of first-time and non-first-time mothers and permutation tests are conducted comparing scores on Knowledge of Infant Development Inventory (KIDI-SF) scores among the high and low treatment groups for first-time mothers alone and then a separate analysis for non-first-time mothers. The analysis of first-time mothers shows that the high treatment group still outperforms the low treatment group on the KIDI-SF measure ($p<.05$, $d = .40$), however the analysis of the non-first-time mothers shows that the differences between the high and low treatment groups no longer reach significance. This suggests that the observed difference between the high and low treatment groups is largely due to variations in knowledge among first-time mothers. As women in the sample who are pregnant with their first child have less knowledge of child development than women who have at least one child, it is possible that the *PFL* programme may have differential effects depending on whether the *PFL* child is a first child or not. Thus, future sub-group

analyses depending on first-time parent status will be conducted when analysing treatment effects.

Table 4
Summary of Permutation Tests Examining Differences at Baseline

Domain	Number of measures which do not fail to reject the null hypothesis	
	PFL Low – *PFL* High	*PFL* – Comparison Community
Family Socio-demographics	33/33 (0%)	27/33 (82%)
Maternal Well-being	24/24 (0%)	18/24 (75%)
Maternal Health and Pregnancy	35/35 (0%)	26/35 (74%)
Parenting	10/13 (77%)	6/13 (46%)
Social Support	17/18 (94%)	9/9 (0%)
TOTAL **NOT** STATISTICALLY DIFFERENT	119/123 (97%)	86/114 (75%)

Note: P values derived from permutation tests with 20,000 replications. A *p*-value of less than .05 is considered to be statistically significant.

Aggregate PFL Group v Comparison Community Group

Table 4 also examines differences between the *PFL* cohort and the comparison community at baseline to test for the comparability of this group. It is important to note that participants in the comparison community were not randomised into this group. Rather, they were invited to participate in the study as they were pregnant women living in an area that is socio-demographically similar to the *PFL* area. Table 4 shows that the aggregate *PFL* group and the comparison community do not statistically differ on 75% of the measures analysed, suggesting a degree of similarity between the two groups. However, the 25% of measures on which differences emerge suggest that the comparison community is a relatively higher socioeconomic status cohort.

Specifically, mothers and fathers in the comparison community are significantly older than *PFL* parents ($p<.05$, $d = .32$), they have less literacy and numeracy problems ($p<.05$, $d = .28$), and fewer are living in social housing ($p<.05$, $d = .25$). Mothers in the *PFL* community display

more vulnerable attachment styles ($p<.05$, $d = .26$), while the comparison community report higher rates of self-efficacy ($p<.05$, $d = .18$), suggesting that mothers in the comparison community have stronger beliefs in their ability to effectively parent her child/children. Furthermore, the comparison community report greater consideration of future consequences ($p<.05$, $d = .27$).

In terms of health, mothers in the comparison community report experiencing more mental health conditions ($p<0.5$; $d = .24$) as well as using more health services in the past year ($p<0.5$; $d = 0.16$). Although more mothers in the *PFL* community report smoking during pregnancy ($p<0.5$; $d = 0.30$), mothers in the comparison community report consuming more alcoholic beverages per week during pregnancy ($p<0.5$; $d = 0.03$). Additionally, mothers in the comparison community are more likely to report that their pregnancy was planned ($p<.01$, $d = .40$), that they are participating in antenatal classes ($p<.05$, $d = .31$), and they are taking more iron supplements ($p<.05$, $d = .25$). Several differences also emerged between the *PFL* group and the comparison group in terms of parenting risk of abuse and neglect. Specifically, mothers in the comparison community display lower levels of risk of abuse and neglect across six of the seven measures related to parenting ($p<.01$, $d = .38$). Finally, more mothers in the comparison community intend to breastfeed their new child ($p<.01$; $d = .37$).

In sum, these results show that the mothers in the comparison community are, for the most part, faring better than mothers in the *PFL* community on domains which have been shown to have clear relationships with child developmental outcomes. One exception, however, is that mothers in the comparison community reported more incidences of mental health conditions as well as greater usage of health services in the last year. These two exceptions complement each other as greater use of health services may facilitate a greater awareness of any condition that a mother is experiencing.

7. CONCLUSION

This paper describes the programme and evaluation design of a community-led early childhood intervention that is on-going in Ireland. The analysis of the baseline data reveals that the *PFL* sample represents a highly disadvantaged group in terms of education, employment, mental health and pregnancy behaviour. There is substantial evidence indicating that being born into disadvantaged communities can severely hamper a child's cognitive and non-cognitive skills (Heckman, 2007), which subsequently impact on their future development including both social and labour market outcomes (Duncan, Ziol-Guest, & Kalil, 2010; Duncan et al, 2007). From a cost-benefit perspective it is particularly important to reach the *PFL* population as such high dependency communities place a significant burden on public finances. A cost-benefit analysis of a US home visiting programme found that the Nurse-Family Partnership generated a return of $2.88 for every dollar invested (Karoly et al. 2005). The Nurse-Family Partnership, which closely resembles the *PFL* programme, has been found to generate long term effects for the participating parents regarding maternal employment, reduction in welfare use and government assistence, lower incidence of child abuse, and for the participating children it has resulted in improved prenatal health, improved school readiness, and fewer childhood injuries (Olds et al. 1986; Olds et al. 1997; Kitzman et al. 1997; Olds et al. 2002; Kitzman et al. 2010; Olds et al. 2010).

Overall, the analysis of the baseline data reveals that the randomisation procedure was effective in equally distributing participants between the high and low *PFL* treatment group in terms of their baseline characteristics. As demonstrated, the treatment groups were statistically different on only 3% of the measures analysed. This provides quantitative evidence that the low and high treatment groups were similar in terms of socio-demographics, health, well-being, parenting, and social support before engaging in the *PFL* programme. This indicates that future analysis of treatment effects over the course of the five year

evaluation can be causally attributed to the programme and used to determine its impact on children's school readiness skills.

The selection of the comparison community, which was based on a quasi-experimental design, was less effective in identifying a comparison sample which did not substantially differ from the *PFL* sample. In general, the comparison group display a higher socioeconomic status profile compared to the *PFL* sample. Thus, future analyses concerning the comparison group must account for these differences as failing to control for such difference may bias the impact evaluation results by reducing the magnitude of the treatment effect. In subsequent analysis of the treatment effects, we will use a conditional permutation testing procedure to control for these differences when comparing the outcomes of the two *PFL* treatment groups and the comparison community group (see Heckman et al. (2010) for a description of this method).

The data presented in this paper will be linked to future outcomes throughout the six remaining waves of data collection. In addition, as additional waves of data are collected when the *PFL* cohort is 6, 12, 18, 24, 36, and 48 months of age, longitudinal effects testing the effectiveness of the *PFL* programme will be analysed. Permutation based methods will be used to identify treatment effects at each time point, and the stepdown procedure will be adopted to account for multiple hypotheses testing (see Romano and Wolf, 2005). Such rigorous analyses will enable us to determine whether the programme is having an impact on child, parent and family outcomes over time and provide new knowledge on the optimal methods for breaking the cycle of deprivation in disadvantaged communities.

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Table 1A
Summary of Baseline Measures

Domains	No. of measures	Measures/Instruments
Parental Socio-demographics	33	**Demographics** (Mother's Age; Teenage Mother; Primiparous Mother; Number of Biological Children; Mother in a Relationship; Mother Married; Biological Father's Age; Teenage Father; Ethnicity) **Parental Education** (Mother with Junior Certificate Qualification or Lower; Mother with Primary Degree; Age Mother Left Full-time Education; Mother with Literacy/Numeracy Problems; Father with Junior Certificate Qualification or Lower; Father with Primary Degree; Age Father Left Full-time Education) **Parental Employment** (Mother in Paid Work; Mother in Full-time Work; Annual Income of Working Mothers; Mother Unemployed; Father in Paid Work; Father in Full-time Work; Annual Income of Working Fathers; Father Unemployed) **SES** (Household Annual Income; Residing in Social Housing; In Possession of a Medical Card; In Possession of Private Health Insurance; In Receipt of Social Welfare Payments; Saves Regularly; Materially Deprived; Material Deprivation Index; Ability to make ends meet)
Maternal Well-being	24	**Well-being** (WHO-5 Well-Being Index Percentage Score; Low WHO-5 Percentage Score (World Health Organisation, 1998); Incidence of Postnatal Depression in Previous Pregnancies) **Vulnerable Attachment Style Questionnaire** (VASQ; Bifulco, Mahon, Kwon, Moran, & Jacobs 2003) (Insecurity Score; High Insecurity; Proximity Seeking Score; High Proximity Seeking; Total Vulnerable Attachment Score; High Vulnerable Attachment) **Pearlin Self Efficacy Scale** (Pearlin & Schooler, 1978) (Mastery; Lowest 10% Mastery; Parenting Self Efficacy; Lowest 10% Parenting Self Efficacy; Total Self Efficacy Score; Lowest 10% Total Self Efficacy Score) **Rosenberg Self Esteem Scale** (Rosenberg, 1965) (Total Self Esteem Score; Lowest 10% Self Esteem Score) **Ten Item Personality Inventory** (Gosling, Rentfrow, & Swann, 2003) (Extraversion; Agreeableness; Conscientiousness; Emotional Stability; Openness to Experience) **Consideration of Future Consequences Scale** (CFC; Strathman et al., 1994) **Indicators of Household Social and Emotional Risk**
Maternal Health and Pregnancy	35	**Health in Childhood** (Self Rated Ill Health as a Child; Missed School for One Month Due to Ill Health) **General Health Status** (Self Rated Ill Health; Long Term Chronic Illness; Physical Health Condition; Mental Health Condition; Pre Pregnancy BMI; Obese/Overweight)

		Maternal Health Behaviours (Healthy Eating Scale; Regular Exercise; Health Service Use; # Health Services Used in Previous Year; # of Non-pregnancy Related GP Visits in Previous Year) **Pregnancy** (Age at First Pregnancy; Birth Control Practices; Planned Pregnancy; Week Pregnancy Confirmed; Week of First Antenatal Visit; Participation in Antenatal Classes) **Health Supplement Use** (Multivitamins; Folic Acid; Iron; Calcium; Other Health Supplement) **Maternal Substance Use** (Smoking During Pregnancy; Change in Smoking Status During Pregnancy; # Cigarettes Smoked per Day; # Drinks per Week (before pregnancy); Drinking During Pregnancy; # Drinks per Week (during pregnancy); Change in Drinking Alcohol Status During Pregnancy; Ever Used Drugs Before Pregnancy; Ever Used Drugs During Pregnancy; Change in Drug Status During Pregnancy)
Parenting	13	**Knowledge of Infant Development Short** Form (KIDI-SF; MacPhee, 1981) (KIDI Score, Lowest 10% KIDI-SF Score) **Adult Adolescent Parenting Inventory** (AAPI-2; Bavolek & Keene, 1999) (Parental Expectations of Children, Parental Empathy Towards Children's Needs, Use of Corporal Punishment, Parent-child Family Roles, Children's Power and Independence, Total AAPI-2 Score, Total Number of Scales At Risk) **Breastfeeding Intentions** (Breastfed Previous Child, Intention to Breastfeed Current Child) **Childcare Intentions** (Intention to Use Childcare, Age Intend to Start Childcare)
Social Support & Service Use	18	**Social Support** (From Partner, From Parents, From Relations, From Friends, From Neighbours, From People in Workplace, Frequency of Meeting Friends/Relatives, Number of Neighbours Known Personally, Satisfaction with Neighbourhood) **Service Use** (Emergency Services, Health Services, Child/Family Services, Employment Services, Community Services, Residents Associations, Adult Education Services, Other Useful Services, Total Service Use)