

Evaluation of Health in Pregnancy grants in Scotland: a natural experiment using routine data

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Scientific summary

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Background

Pregnancy and the perinatal period are critical stages for the development and improvement of population health. Lower birthweight babies have a higher risk of adverse perinatal outcomes and, although mean birthweight has increased in the UK, the social patterning of birthweight has become more pronounced. Low birthweight also has an impact on adult health; it is associated with a higher risk of coronary heart disease death and diabetes mellitus. An improvement in fetal nutrition may, therefore, have far-reaching consequences in terms of the prevention of disease. Antenatal care is widely considered to be an effective method of improving pregnancy and birth outcomes, through its ability to offer advice and help regarding the modification of health behaviours. For such care to be effective, it should be offered in a timely manner, that is, early in the pregnancy.

This study evaluates the clinical effectiveness and cost-effectiveness of the Health in Pregnancy (HiP) grant. This was a universal, unconditional cash transfer of £190 for women in Great Britain and Northern Ireland reaching 25 weeks of pregnancy if they had sought health advice from a doctor or midwife. The grant was introduced for women with a due date on or after 6 April 2009 and was subsequently withdrawn for women reaching the 25th week of pregnancy on or after 1 January 2011. It was intended to provide additional financial support in the last months of pregnancy to contribute towards a healthy lifestyle (e.g. in terms of diet), and it was suggested that the link to the requirement for pregnant women to seek health advice from a health professional may provide an incentive for expectant mothers to seek the recommended health advice at the appropriate time. The grant was paid by Her Majesty's Revenue and Customs to pregnant women on receipt of a claim form partly completed by a doctor or midwife, and the programme was paid for by Her Majesty's Treasury.

Our evaluation was restricted to Scotland and used the high-quality and complete maternal hospital discharge forms linked to the birth registration system (Scottish Birth Records).

Objectives

Our objective was to evaluate the clinical effectiveness and cost-effectiveness of the HiP grants in Scotland. We did this by assessing the difference in birthweight between babies born to those mothers who were eligible for the HiP grant, and babies born either before the HiP grants were introduced or after they were withdrawn. Specific questions that we address include the following:

- Did the HiP grant result in a change in birthweight (our primary outcome measure) or any of a number of secondary outcomes grouped as measures of maternal behaviour [gestation at booking (i.e. the first antenatal appointment with a health-care professional), booking before 25 weeks and maternal smoking during this pregnancy], measures of size [very low birthweight (< 1500 g), low birthweight (< 2500 g), high birthweight (> 4000 g), crown-to-heel length and head circumference], measures of stage [gestational age at delivery, preterm (< 37 weeks), very preterm (< 32 weeks), weight for dates (standardised, small and large for gestational age)] and birth outcomes (elective caesarean section, emergency caesarean section, stillbirths, neonatal deaths and 5-minute Apgar score)?
- Were there differential impacts of the intervention for particular subgroups defined by socioeconomic (both area deprivation and individual occupational social class), demographic (marital status, age, ethnicity) or obstetric (parity, maternal obesity, maternal diabetes mellitus) factors?
- Were the HiP grants cost-effective? What were their total aggregate health and cost consequences? How did cost-effectiveness vary across important subgroups identified as having differential outcomes?

Methods

The HiP intervention was evaluated as a natural experiment using interrupted time series analysis. The interrupted time series approach allowed us to compare an intervention group that received the HiP grant both with a comparison group of pregnant women who delivered before the HiP grant was introduced and with a post-intervention group of women who delivered after the HiP grant was withdrawn.

The data came from the Scottish maternity and neonatal database held by the Information and Services Division at the NHS National Services Scotland. These data are routinely collected information from maternal and birth records from all hospitals in Scotland. Individual birth records were available for analysis in this study. The data covered 10 years from 1 January 2004 to 31 December 2013. During this time, some mothers gave birth more than once. Therefore, the structure of the data was multilevel; births were nested within mothers and mothers were nested within small geographic areas (data zones).

Our primary outcome measure, birthweight, had a completion rate of 99.9%. There was a high completion rate for all outcome variables (< 1.5% missing), with the exception of crown-to-heel length (46.4% missing), head circumference (26.3% missing), gestational age at booking (15.4% missing) and maternal smoking (8.9% missing). Birthweight can be affected by many factors; we were able to adjust for a range of routinely collected obstetric and maternal characteristics such as sociodemographic classifications and medical risks of the current and previous pregnancies, as well as environmental and behavioural characteristics of the mother. In addition, we adjusted for time trends and seasonality in the data.

Extreme data values (implausible observations and outliers) were excluded. A total of 18,276 (3.4%) singleton births delivered between 24 and 44 weeks were excluded, leaving 525,400 births for the main analysis. Item non-response values were imputed using multiple imputation by chained equations. A total of 30 imputed data sets were created and analysed identically, and the results were combined to obtain estimates and standard errors for the multiply imputed data. Multilevel models were used to determine whether or not the outcomes changed during the intervention period in which the HiP grants were in effect. Multilevel linear regression was used for continuous outcomes, and multilevel logistic regression was used when the outcome was dichotomous. Results from imputed data were compared with those from complete cases, but the results from the imputed data were favoured because these take into account the non-random pattern in data missingness.

Subgroup analyses were conducted for those groups seen as having the greatest potential to benefit from the payments, namely those living in the most deprived areas, those in the 'never worked' social class group, those in the 'manual worker' social class group, lone mothers and teen mothers, and for mothers for whom an increase in mean birthweight was not desirable, namely obese mothers and mothers with diabetes mellitus. For each group the main analysis was replicated and the results from the combined analysis of the 30 imputed data sets are reported.

Ethnicity was poorly recorded in the routine data set, with 56.5% of data missing over the 10-year period. Missingness varied across the years: 83.3% of data were missing in 2004 and 23.6% of data were missing in 2013. Ethnicity was not imputed and was not included in the main analyses. In order to gauge the effect of ethnicity on the HiP grant intervention, analyses were carried out on the subgroup of non-white mothers identified in the data set. In addition, the models for the complete cases were fitted to include ethnicity along with other covariates.

Different forms of sensitivity analysis were conducted in an attempt to ascertain whether or not any effects were attributable to the HiP grant. The exact window in which the intervention was in place was defined by two parameters, namely the start date (a due date of delivery on or after 6 April 2009) and the duration of the intervention (2 years). We allowed both the start date and duration to vary; five different start dates and three different durations were chosen, giving 15 different windows tested. In all cases in which this window differed from the real intervention period, a dilution of any effects of the HiP grant was expected.

The introduction of the smoking ban in public places in Scotland in March 2006 may have had an effect on the level of smoking in pregnant women and, therefore, may have affected the rate of change of birthweight of babies born after this time, as well as other outcomes examined. We carried out a further analysis, restricting the pre-intervention period to 1 January 2007 to 1 April 2009, to ensure that pregnancies included in the pre-intervention period were all after the smoking ban had come into effect.

The effect of the HiP grant on birthweight and other secondary outcomes might have had a carryover effect after the withdrawal of the programme. In other words, the trend in birthweight post intervention might not return to the same rate as pre intervention. This contamination could be attributable to women who gave birth during the intervention subsequently having a birth post intervention but still heeding the health advice given during their first pregnancy. An additional analysis using only the subgroup of primiparous women was carried out to avoid such contamination.

In 2009 there was an outbreak of swine flu (influenza virus A/H1N1pdm09) in Scotland (and the rest of the UK). Pregnant women were adversely affected by this virus, resulting in poorer perinatal outcomes. There were two outbreak periods, in July 2009 and October–November 2009. To try to take this into account, a further analysis removing births from 1 July 2009 to 30 November 2009 in the intervention period was carried out.

Health and cost consequences were mediated through either a birthweight or gestational age at birth perspective, in addition to smoking during pregnancy. All costs were presented in 2015 Great British pounds using the Hospital and Community Health Services index to adjust. Health and cost changes during the intervention period were presented relative to the pre-intervention period. The model used was based on the incremental numbers of cases (of preterm, low birthweight or poor maternal outcomes) attributable to the HiP grant. Unit costs by outcomes were based on published results.

Results

The mean birthweight for live singleton births during the study period was 3418 g. There was no statistically significant effect of the intervention on birthweight, with birthweight during the intervention period being, on average, 2.3 g [95% confidence interval (CI) –1.9 to 6.6 g] lighter than would have been expected had the pre-intervention trend continued. [The general trend was one of birthweight increasing by 3.3 g per year (95% CI 2.4 to 4.2 g).]

There was no statistically significant effect of the HiP grants on most of the measures of stage and size. However, compared with the pre-intervention period, maternal booking behaviour changed during the intervention period. The mean gestational age at booking decreased by 0.35 weeks (95% CI 0.29 to 0.41 weeks) during the period when the grant was in place, and the odds of booking before 25 weeks increased by 10% [odds ratio (OR) 1.10, 95% CI 1.02 to 1.18]. However, the odds of neonatal death increased by 84% (OR 1.84, 95% CI 1.22 to 2.78), and the odds of having an emergency caesarean section also increased by 7% (OR 1.07, 95% CI 1.03 to 1.10) during the intervention period.

The decrease in mean gestational age at booking seen during the intervention period was extended post intervention; relative to the pre-intervention period, mean gestational age at booking was 1.10 weeks (95% CI 1.02 to 1.20 weeks) lower post intervention. However, following the withdrawal of the HiP grants there was a small decrease in the odds of booking before 25 weeks (OR 0.91, 95% CI 0.83 to 1.00).

These findings were largely replicated across subgroups. For example, looking at fifths of the population defined by area deprivation, there was a small decrease in mean birthweight during the intervention period in the most deprived areas [12.2 g (95% CI 3.6 to 20.8 g)] but no significant difference in the other groups. Mean gestational age at booking decreased in all deprivation groups, but slightly more so in the more deprived area groups; there was a reduction of 0.5 weeks (95% CI 0.4 to 0.6 weeks) in the most deprived 20% of areas and a reduction of 0.2 weeks (95% CI 0.1 to 0.4 weeks) in the least deprived 20% of areas.

The HiP grants were not associated with any significant changes in birthweight, gestational age or maternal outcomes. As a result, their impact on costs was negligible. The total estimated grant cost was £20.4M.

Conclusions

There was no impact of the HiP grants on birthweight, our primary outcome measure. In fact, most measures of stage or size appeared to be little changed by the intervention. There was, however, some influence on health-care-seeking behaviour, namely gestational age at booking and the likelihood of booking before 25 weeks. Other studies have similarly shown that behaviour can be changed through relatively modest financial incentives.

It is likely that the decrease in mean gestational age reflects the introduction and pursuit of a Health improvement, Efficiency and governance improvements, Access to services, Treatment appropriate to individuals (HEAT) target related to earlier booking for antenatal care. The same is not true, however, for the increase in the odds of booking before 25 weeks. The target of 25 weeks was related to the eligibility for the HiP grants and not to the HEAT targets, and the decrease in the odds of booking before 25 weeks following withdrawal of the intervention appears to be a response to the withdrawal of the incentive. Those failing to book before 25 weeks were notably disadvantaged compared with those booking earlier, particularly in terms of lone parenthood, worklessness and the mother being under 20 years of age.

It is unclear why increases were seen for the probability of neonatal mortality and caesarean sections. Both remained high following withdrawal of the intervention. It is possible that both were affected by wider environmental factors that coincided with the intervention period, such as the global financial crisis and the swine flu pandemic of 2009.

Our study was limited by the implementation of the HiP grants in a way that neither was randomised nor facilitated their evaluation.

Our recommended priorities for future research are as follows:

1. Test whether an eligibility threshold earlier than 25 weeks would lead to increased exposure to antenatal care and advice (increased frequency of antenatal visits) and whether any accompanying change in health behaviour (such as smoking or diet) occurring earlier in the pregnancy would lead to improvements in maternal and infant health outcomes. Evaluate the economic benefit that can be achieved through such a modified threshold and any consequent improvement in results.
2. Evaluate whether or not this intervention has greater impact, and higher cost-effectiveness, when delivered as a targeted intervention or as a universal intervention.
3. Test if outcomes differ depending on whether or not the payment is conditional or unconditional.
4. Investigate the relationship between the size of the payment and subsequent outcomes.

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