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FAMILY INCOME AND BIRTH WEIGHT

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Abstract

Previous research has shown that low birth weights have negative effects on outcomes throughout life. Using administrative data from the Israeli Ministry of Health and the Israeli National Insurance Institute, this study examines the relationship between family income and birth weights (for single births) in Israel between 1995 and 2007. Raw data display a positive correlation between parents' socioeconomic characteristics, including income, and their children's birth weights. However, examining the effect of exogenous changes in family income – such as variations in the amount of child allowances – on birth weights (including for the same mother) reveals that the causal relationship is for the most part statistically insignificant. Even when a statistically significant causal relationship is detected, it is weak and, according to the literature, would have no effect on life outcomes.

1. INTRODUCTION

The association between birth weight and indicators of development has received a great deal of attention from researchers worldwide. The findings indicate that low birth weights lead to an increased rate of mortality and illness and a decrease in scholastic achievement,

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earnings, etc. and therefore, birth weight constitutes a rough index of a newborn's initial health capital. These effects are more pronounced among newborns of mothers from a weak socioeconomic background. Therefore, governments commonly fund intervention programs to assist pregnant women, particularly disadvantaged ones, in order to improve the health status of their newborns, which includes reducing the incidence of low birth weight.

The findings in the literature indicate that birth weight is influenced by a number of factors that are related to the mother and her family, such as genetic and physiological factors, health status and level of health care, behavior (such as abstinence from smoking) and demographic/socioeconomic characteristics. Although birth weights are on average lower in poor households, only few studies have found a causal relationship between household income and birth weight.

This study examines the relationship between the demographic/socioeconomic characteristics of families in Israel, particularly their level of income, and birth weight, while differentiating between various population groups and focusing on low-income families. The research population encompasses all live births in Israel during the years 1995–2007, which numbered about 1.8 million. The database is based on the merging of the live births file of the Ministry of Health, which includes birth weight, with administrative files from the National Insurance Institute, which include demographic characteristics of the mothers and their spouses, as well as their salaries and transfer payments they received.

The raw findings indicate that birth weight (in single births) increases with family income in all population groups. Thus, the weight of newborns with parents in the upper tercile of the income distribution is higher by 30 grams (about one percent) than that of newborns with parents in the lowest tercile. The study begins by examining the correlation between family income and birth weight and finds that it is positive.[1] First, it was found that changes in family income over time for a given mother are correlated with changes in the weights of high-order newborns. In other words, a drop in family income between births is associated with a decline in the weight of a later newborn relative to an earlier one (no such correlation was found with newborns of a lower order).

Nonetheless, other factors (such as the health status of the mother) are likely to influence both changes in a given mother's income and birth weights. Therefore, the study also examined how birth weights were affected during the sample period by exogenous changes in child allowances, which were substantial for high-order children (see Appendix B). The estimation results show that due to the sharp cuts in child allowances, birth weights of high-order children declined, which in theory indicates a causal relationship between the two. However, a similar correlation was also found between the cut in child allowances and the weight of lower-order newborns, whose parents were not affected by the change. A test that focused on the large increase in child allowances among some Bedouin families did not find that it had a significant effect on birth weight relative to the birth weight of similar newborns for whom the child allowance was unchanged.[2]

[1] The reasons for this positive correlation require additional research. It can be assumed that this is related to, among other things, the income effect on nutrition and other factors (see the review of the literature below).

[2] These findings are based on a small number of observations and therefore should be treated with appropriate caution.

In summary, the existence of a causal component in the correlation between family income and birth weight cannot be proved or disproved and even when a causal relationship was found it was a weak one and, according to the literature, would not have an impact on life outcomes.

The study is divided as follows: Section 2 presents a review of the literature. Section 3 describes the database and provides descriptive statistics and Section 4 describes the empirical results. Appendix C contains a short discussion of other factors (aside from income) that may explain the low weights of Bedouin newborns in southern Israel and particularly close-kin marriages.

2. REVIEW OF THE LITERATURE

The literature points to several factors that positively affect birth weight and reduce the probability of low birth weight (i.e. under 2,500 grams) or very low birth weight (i.e. under 1,500 grams). These include: a) genetic and physiological factors, which include belonging to a certain population group, a male newborn, normal weight of the mother during pregnancy and at the time of the birth, her height and the height and weight of the father; b) demographic/socioeconomic factors, which include higher maternal age at the time of the birth, whether the mother is married, and a high level of parental schooling and income; c) birth-related characteristics, which include a high birth order and widely-spaced births; d) behavioral factors, which include abstinence from smoking, alcohol and drugs, appropriate nutrition during pregnancy, physical activity, avoidance of exposure to dangerous substances and/or physically strenuous work and non-close-kin marriages; and e) good health status and health care, which includes the absence of illness (such as pre-eclampsia)[3] and of birth defects in the mother, good mental health and regular monitoring of the pregnancy's development.

The main factors explaining low birth weight in advanced economy countries are first and foremost smoking, following by improper nutrition[4] and underweight mothers. For further details, see Kramer (1987), Rosenzweig and Wolpin (1991), Gribble (1993), Joyce (1998), Warner (1998), Meara (2001), Currie and Moretti (2003), Finch (2003) Sastry and Hussey (2003), Conway and Kennedy (2004), Dehejia and Lleras-Muney (2004), Kaestner and Lee (2006), Lauderdale (2006), Camacho (2009), Fertig and Watson (2009), Reichman et al. (2009), Walker et al. (2009) and Fertig (2010). It is worth emphasizing that a high socioeconomic status is likely to affect the health of newborns through a number of channels, including earlier discovery of pregnancy, better access to health services, an understanding of the necessary medical treatment and abstinence from harmful habits such as smoking.

Several studies have dealt with the relationship between household income and birth weight. They have focused primarily on the Supplemental Nutrition Program for Women, Infants and Children (WIC) which is implemented in the US and provides food stamps to

[3] In contrast, gestational diabetes accelerates the growth of the fetus and increases birth weight.
[4] Studies have shown a close relationship between a low level of income and nutritional insecurity.

pregnant women in poor families. Studies that have analyzed the impact of the program on birth weight arrived at mixed results (for a review, see Figlio et al., 2009; and Hoynes et al., 2009), with some studies finding no impact on average birth weight and others finding a positive impact and in some cases even a reduction in the proportion of underweight newborns. Currie and Cole (1993) did not find that participating in Aid to Families with Dependent Children (AFDC), a program that provides financial assistance to poor families, had a positive effect on birth weight, though it may make a positive contribution to birth weight for the newborns of white women.

The effect of the business cycle and other changes in economic variables on birth weight has been tested in a number of studies. Thus, for example, Bozzoli and Quintana-Domeque (2010) found that the major economic crisis in Argentina in 2002 (involving a decrease of about 11 percent in GDP) led to an average drop of 30 grams in birth weight within six months of the onset of the crisis, and even more for mothers from a weak socioeconomic background. Dehejia and Lleras-Muney (2004) found that during a recession in the US, which included an increase in the rate of unemployment, there was a change in the socioeconomic distribution of pregnant women and changes in behavior that have an impact on health (such as a reduction in smoking and the consumption of alcohol). As a result, there was an increase in average birth weight during a recession. In Zanzibar, an instrumental variable was used to isolate the effect of income on birth weight: As the result of a month-long electricity outage in Zanzibar, which reduced individual incomes in a differential manner, birth weights fell and the probability of a low birth weight increased (Burlando, 2010).

Studies carried out in Israel found that a high level of parental schooling reduces the probability of low birth weight (see, for example, Orbach, 2006). These studies were based primarily on the Jerusalem Perinatal Study, which included births in western Jerusalem from 1964–1976 and questionnaires that were filled out at post-natal clinics.

There is a vast literature that points to the negative impact of relatively low birth weight on a variety of life outcome variables, both in the short and long terms. These include: a) mortality; b) medical problems in general and chronic illness (such as diabetes, high blood pressure, heart disease and respiratory problems) and birth defects in particular, which are explained by the fact that the fetus did not grow sufficiently and experienced permanent physical changes or alternatively that the fetus' slow rate of growth was the result of genetic disorders that were also manifested after the birth; c) behavioral problems; d) reduced cognitive abilities and lower levels of schooling and scholastic achievement; e) lower earnings; and f) a negative effect on offspring (such as, for example, low birth weight). The effect is generally a weak one apart from the case of low or very low birth weight and in any case the effect is greater among mothers from a weak socioeconomic background.[5] For further details, see Table A1 in Appendix A and also Conley and Bennett (2000), Behrman and Rosenzweig (2004), Almond et al. (2005), Black et al. (2007), Curie

[5] The negative effect of low birth weight on outcome variables can be stronger or weaker depending on the quality of parental care. Datar et al. (2010) found that the negative impact is intensified (parents provide better care to normal-weight newborns relative to underweight newborns) in contrast to Loughran et al. (2008) who found the opposite.

and Moretti (2007), Lin et al. (2007), Loughran et al. (2008), Oreopoulos et al. (2008), Del Bono and Ermisch (2009) and Royer (2009).

Studies that examine the relationship between birth weight and outcome variables are primarily based on the difference in weight between twins or siblings, which is for the most part random, since they have a common genetic makeup and have developed in a similar environment. Thus, the findings are likely to provide evidence of causality. However, it is still difficult to identify causality in this case since it is unclear whether the outcome variables are the result of a low birth weight or some other family-related factor that has had a simultaneous effect on birth weight and was genetically transmitted and/or continued to affect the growth of the child after birth.

Studies in Israel have found that, as expected, very low weight newborns have higher rates of mortality and health problems, lower levels of intelligence and relatively low levels of motor and cognitive functioning (Suzan, 1988; Levi, 1991; Gornish-Wilchek, 1997; and Friedlander et al., 2003). In contrast, a study of twins (Elisar, 1996) in which one twin was born at a normal weight and the other at a low weight did not find any differences in functioning (neurological, mental or motor) at a young age. Paltiel et al. (2004) found a *positive* correlation between birth weight and the incidence of cancer (leukemia).

3. THE DATABASE AND DESCRIPTIVE STATISTICS

a. The database

The database consists of the National Insurance Institute files used by Toledano et al. (2009), which were merged with the file of live births obtained from the Ministry of Health.

The National Insurance Institute files include all Israeli women (numbering about 2 million), born during the period 1950–1995, i.e. women who were in their fertile years from the mid-1990s until the end of 2007. The files include the women's demographic characteristics and those of their spouses, as they appear in the Population Registry. In addition, annual data was gathered on the employment and wages of the women and their spouses and on the various transfer payments they received (child allowance, income supplement, general disability, alimony, etc.). The file of live births for 1995–2007 includes the weights of about 1.8 million newborns, as well as the identity numbers of their mothers, which were used to merge it with the National Insurance Institute files.[6]

This study differentiates between population groups. Among Jews,[7] it differentiates between the ultra-Orthodox and others; among Arabs, between Bedouins in the South (Arabs in the southern district), Bedouins in the North (Arabs in the Bedouin settlements in

[6] No birth weight was recorded for about 0.6 percent of the newborns. A cross-check of the file of child allowance payments with the Ministry of Health file of live births showed that only a negligible number of births in Israel do not appear in the file of newborns.

[7] Included among the Jews are non-Jewish immigrants (apart from Lebanese who arrived in Israel as a result of Israel's withdrawal from southern Lebanon in 2000).

the northern district),[8] Arabs in eastern Jerusalem, Other Arabs (no differentiation was possible between Muslims and Christians) and Druze (including Circassians). A woman is defined as ultra-Orthodox if she studied or is studying in an ultra-Orthodox seminary and/or is married to a man who studied or is studying in a yeshiva and did not serve in the army or served up to one year, as well as a woman for whom the following relatives fit the above definition of ultra-Orthodox: at least two siblings, father and/or mother, at least two sons/daughters and a woman whose husband has two such relatives (for further details, see Toledano et al., 2009).

The differentiation between various population groups is necessary in view of the possible differences in genetic makeup, lifestyle, etc. Such differences may directly affect birth weight while, at the same time, they may not be observable. Thus, for example, the rate of close-kin marriages is much higher among non-Jews than among Jews (see Appendix C) and the proportion of Jewish non-ultra-Orthodox women who smoke is much higher than for other women (see Table A5 in Appendix A), two characteristics that, according to the literature, reduce birth weight.

b. Descriptive Statistics

During the period 1995–2007, there were 1.77 million births registered in the Ministry of Health's live births file, of which 5.5 percent were multiple births. Hereafter, the study will only relate to single births. The average (median) birth weight was 3,258 (3,270) grams—3,340 grams for boys and 3,200 for girls—with a standard deviation of about 500 grams. The distribution of birth weight for girls is shifted left relative to the distribution of boys (Figure 1). The proportion of boys born with a weight of under 2,500 grams was 5.2 percent while that of girls was 6.4 percent. The proportion of newborns with a weight of under 1,500 grams was 0.6 percent for both genders. In contrast, the proportion of newborns with a weight of over 4,000 grams was 8.0 percent for boys and 4.3 percent for girls. The weight of newborns increases with their birth order, particularly in the transition from the first to the second child (Figure 2).

The ranking of average birth weight by population group (Figure 3 and Table A2 in Appendix A) is as follows (in descending order): Druze, Other Arabs, ultra-Orthodox, non-ultra-Orthodox Jews,[9] and Jerusalem Arabs, with behind Bedouins in southern Israel well behind. The distributions of birth weight for each population group are similar and are shifted according to the average weight ranking (Figure A1 in Appendix A). About half of the difference in low birth weights between Bedouins in southern Israel and non-ultra-

[8] Aramsha, Basmat Tab'un, Bir El-Maksur, Bu'eine-Nuyeidat, Demeide, Hamam, Hussniyya, Ibtin, Ka'abiyye-Tabbash-Hajajare, Kamane, Khawaled, Mansiyyet Zabda, Rumat Heib, Sallama, Sawa'id (Hamriyye), Shibli-Humm Al-Ghanam, Tuba-Zangariyye and Zarzir.

[9] In Figure 3, a gap in birth weight opens in favor of the ultra-Orthodox (and Other Arabs) relative to non-ultra-Orthodox Jewish newborns in the transition from a first-order birth to higher orders. A possible explanation may be that the socioeconomic status of non-ultra-Orthodox Jewish families is weaker in the case of a higher-order birth (for example, fifth and higher) relative to a lower order, while the differences in socioeconomic status are relatively small in other population groups that have large families. However, when Figure 3 is duplicated for the population of parents who had at least 5 children, the gap remains.

Orthodox Jews is explained by close-kin marriages and residence in unrecognized settlements, which have poor access to health services and other public infrastructure (see Appendix C).

Analysis of the data shows that during the period 1995–2007, birth weight was relatively stable, apart from the following trends (Figure A2 in Appendix A): birth weights among non-ultra-Orthodox Jewish third-order newborns decreased while those of fifth order increased, and the birth weight of Other Arab newborns of third and fifth order fell by about 50 grams.[10] Thus, based on the raw data, one cannot point to an increase in non-Jewish birth weight starting from the mid-1990s following the significant increase in child allowances for some non-Jews, or to a drop in birth weight in all the population groups during the period 2004–2007 when child allowances were cut drastically, nor was there a decline beyond the trend line among Other Arabs. A similar picture is obtained from an analysis of the proportion of newborns with low birth weights over time (Figure A3 in Appendix A).

It should be remembered that during the sample period, there were changes in behavior patterns and in medical practices, which may have affected birth weights in opposite directions. Factors that tended to raise birth weight include: a continuous drop in the proportion of smokers among women, both Jewish and Arab (Ministry of Health, 2009a); [11] and an increase in the age of mothers giving birth (Statistical Abstract for Israel, various years) and apparently also in their weight.[12] On the other hand, the following factors acted to reduce birth weight: greater frequency of IVF (Ministry of Health, 2009b);[13] an increase in the incidence of Caesarian Sections[14] which are generally carried out relatively early in the pregnancy; and a drop in the proportion of stillborns.[15] The proportion of legal pregnancy terminations among Jews (and others) fell somewhat during the period 1995–2007 while that of non-Jews rose somewhat, though it remained much lower than for Jews

[10] It is worth mentioning that the incidence of poverty grew among non-Jews (also without including eastern Jerusalem Arabs) from about 38 percent to about 51 percent during the sample period.

[11] The proportion of smokers among Jewish (Arab) women fell from about 24 (12) percent in 1995 (1996) to about 19 (6) percent in 2007.

[12] According to the literature, parental height and weight, particularly that of the mother, are positively correlated with birth weight. An analysis based on the National Health Survey for 2003-4 showed that among women aged 20-44 differences in weight (after controlling for age) between population groups are very small, if they exist at all. Arab women (not including Bedouins in the South and Druze) weigh about 2 kilograms more than non-ultra-Orthodox Jewish women. Height is similar across the various population groups. There is no accessible data on the development of height and weight over time and according to population group.

[13] The proportion of live births that are a result of IVF grew from about 1.7 percent in 1995 to about 3.7 percent in 2007. IVF is not relevant to the study since it is hardly used for higher-order births (since public funding according to the National Heath Insurance Law provides a limited number of treatment cycles and the parents' participation in the cost through the supplementary insurance of the health funds is relatively high). In any case, IVF commonly results in multiple births and these were not included in the study.

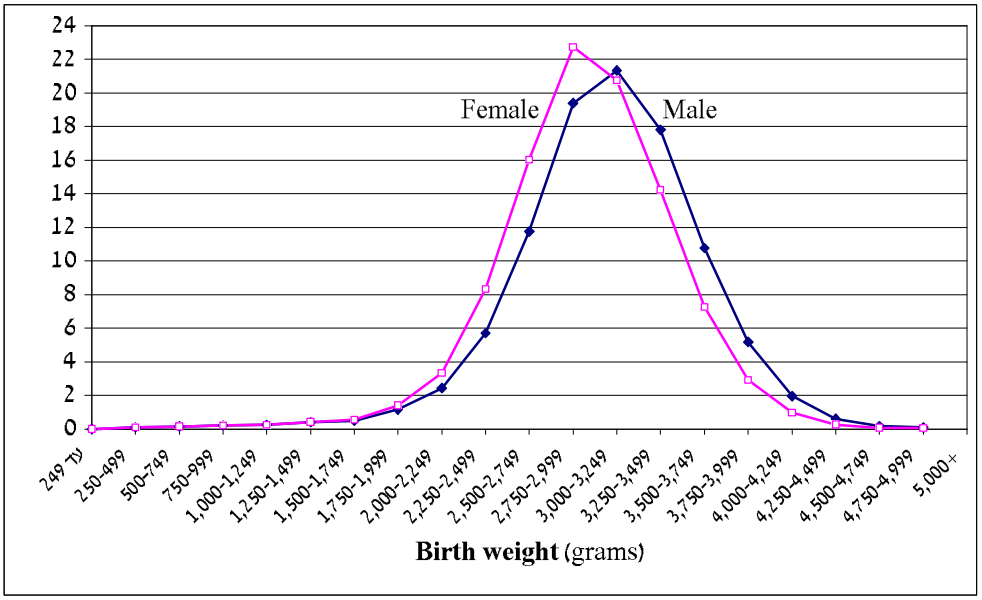
[14] The proportion of Caesarian Sections among total births grew from about 12 percent in 1995 to about 19 percent in 2007 (http://www.euro.who.int/hfadb, World Health Organization – European Health For All Database). There are no available data on the proportion of Caesarian Sections according to population group.

[15] Stillborns are in many cases relatively underweight (Central Bureau of Statistics, 2005) and therefore a decline in the proportion of stillbirths will reduce the average birth weight for live births.

(apart from ultra-Orthodox women)[16] (Central Bureau of Statistics, 2009 and various other years). This may have affected birth weight since some of the reasons for termination, such as defects in the fetus and the mental health of the mother, are correlated with low birth weight.

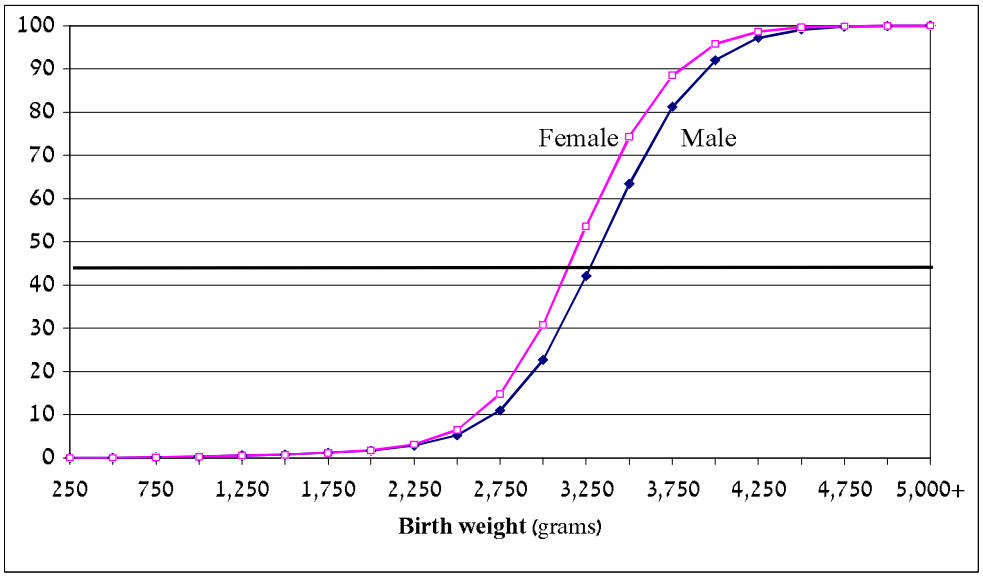
The simple correlation between the socioeconomic status of the parents and low birth weight can be seen in Figure 4. The couple's income during the three years prior to the birth was divided into terciles and it appears that in general, birth weight increases with income within each population group, particularly in the transition from the middle tercile to the upper tercile and among non-Jews. A similar analysis is presented in Table A3 in Appendix A, in which newborns were divided into three weight categories: low (less than 2,500 grams), intermediate (from 2,500 grams up to the average for the population group) and high (above the average). The Table and Figure 5 indicate that newborns in the highest weight category generally have parents with stronger economic indicators (employment rate of the mother and father, salaries and receipt of income supplements) although the differences are smaller in the case of the ultra-Orthodox.

Figure 1
Distribution of birth weight[1] by gender, 1995–2007 (percent)
a. Distribution



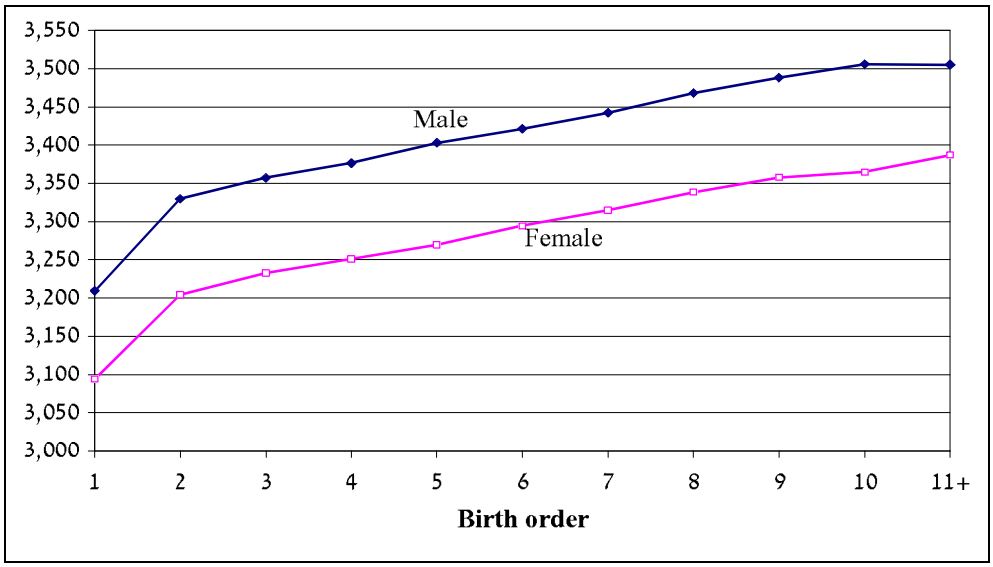
[16] It is worth mentioning that legal termination of pregnancy is more common among women from a relatively weak socioeconomic background (unemployed, low schooling, single mother, etc. [Central Bureau of Statistics, 2008]).

b. Cumulative distribution



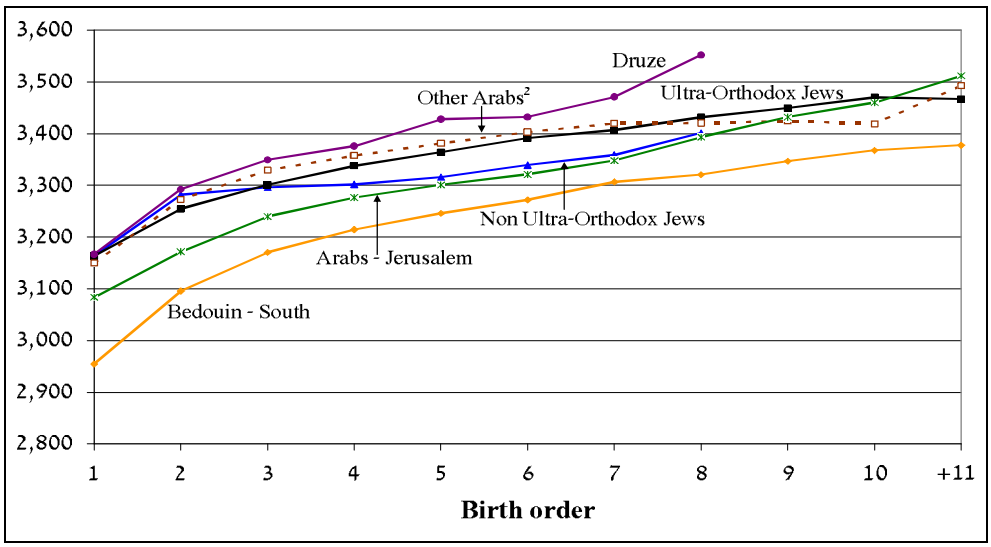
Source: Ministry of Health, National Insurance Institute and calculations by the authors.
[1] Single births.

Figure 2
Average birth weight[1] according to gender and birth order, 1995–2007 (grams)



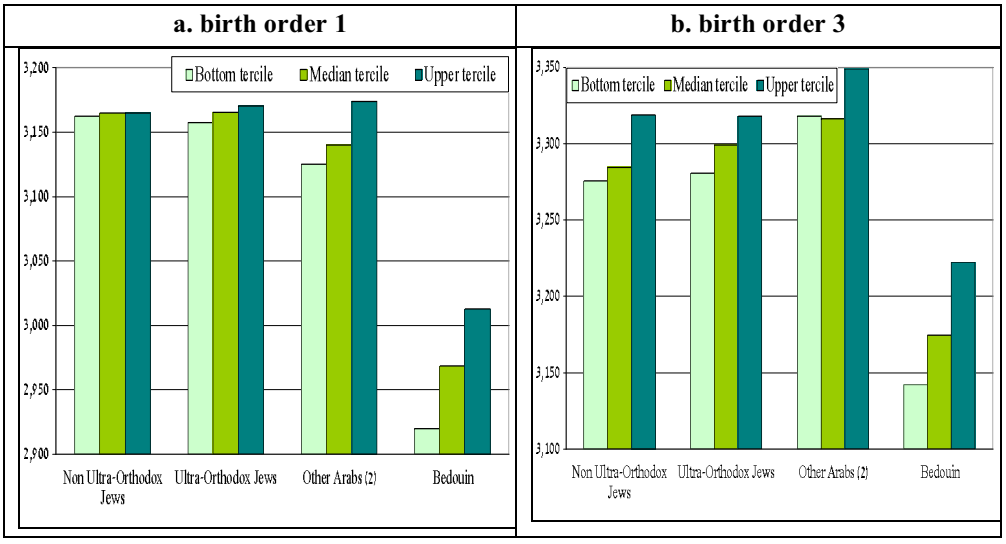
Source: Ministry of Health, National Insurance Institute and calculations by the authors.
[1] Single births.

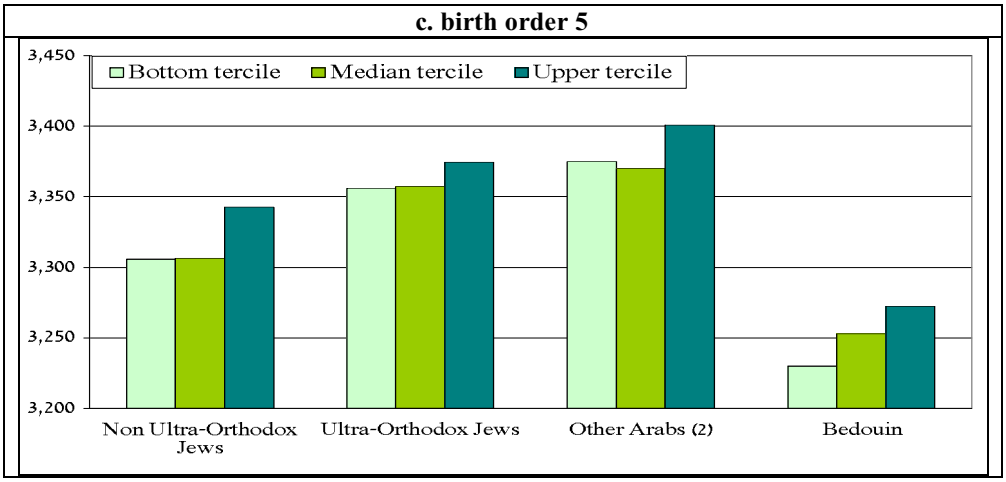
Figure 3
Average birth weight[1] according to population group and birth order, 1995–2007 (grams)



Source: Ministry of Health, National Insurance Institute and calculations by the authors.
[1] Single births.
[2] Arabs who are not Bedouins or residents of Jerusalem (also does not include Druze).

Figure 4
Average birth weight by birth order, income of the parents[1] and population group, 1995–2007 (grams)





Source: Ministry of Health, National Insurance Institute and calculations by the authors.
[1] Single births.
The distribution of the couple's salary income during the previous three years, for each year and population group separately. The distribution was divided into terciles. Self-employed individuals were not included in the calculations.
[2] Arabs who are not Bedouins or residents of Jerusalem (also does not include Druze).

Figure 5
Differences in rate of employment[1] and family income[2] between parents of male third-order newborns[3] with above-average weight[4] and parents of similar newborns weighing under 2,500 grams, according to population group, 1995–2007 (percent)

Source: Table A3 in Appendix A.
[1] Rate of employment in the year prior to the birth.
[2] Annual average salary during the year of the birth and the two years that preceded it, for those that had a positive salary.
[3] Single births.
[4] Average weight of a third-order male newborn according to population group.
[5] Arabs who are not Bedouins or residents of Jerusalem (also does not include Druze).

4. ESTIMATION RESULTS[17]

This section presents the results of the OLS estimations for birth weight. The demographic/socioeconomic characteristics that affect birth weight are presented in Table 1 and in Table A4 in Appendix A for each population group separately. The birth weight for girls is on average about 120 grams lower than for boys. Birth weight increases with the age of the mother at a declining rate (given birth order and other factors) and with birth order and declines when birth occurs shortly after the previous one.

The ranking of birth weight according to population group, other things being equal, is similar to that presented above (and again in descending order): Druze, Other Arabs, ultra-Orthodox, non-ultra-Orthodox Jews, Bedouins in northern Israel, Jerusalem Arabs and, well behind the others, Bedouins in southern Israel, whose newborns weigh 120 grams less on average than non-ultra-Orthodox Jewish newborns. The birth weight among Bedouins in southern Israel who live in permanent settlements is higher than for Bedouins in unrecognized settlements, who comprise the group with the lowest socioeconomic status.[18]

The results in Table 1 indicate that employment and income variables are positively correlated with birth weight. Thus, newborns of employed women weigh about 20 grams more than other newborns and every additional NIS 10 thousand in annual family income is associated with approximately one additional gram of birth weight (Model 1) and more than double that among Bedouins in southern Israel and Other Arabs.[19] The relation between family income and birth weight strengthens somewhat when employment of the mother and her spouse, which is correlated with income, is omitted from the estimation (Model 2). Newborns in families whose income per standard individual is in the upper tercile (for the total population) weigh about 30 grams more than newborns in the bottom tercile, a finding which is consistent with Figure 4 above.[20] It should be emphasized that the relation between birth weight on the one hand and employment, income and other characteristics on the other is not necessarily evidence of causality since it is possible that there are other factors (apart from income) that are correlated with both employment and birth weight (such as smoking and appropriate nutrition). It should be mentioned that the inclusion of dummy variables for population group is liable to bias the estimated coefficient of the income variable downward since population group is strongly correlated with level of income due to the

[17] Due to constraints on computer time, the estimations were performed using a random sample of 20 percent of non-ultra-Orthodox Jewish women. For the rest of the groups, all the observations were used.

[18] According to another finding that is worth mentioning, Jewish newborns of European/American origin, including immigrants from the Former Soviet Union who arrived since the early 1990s, weigh more than newborns of native Israelis (Table A4 in Appendix A).

[19] Note that the size of the family is taken into account (i.e. per capita family income) through the inclusion of birth order in the estimation (which appears primarily due to its physiological effect on birth weight).

[20] Given the gap in average family income per standard individual between the upper and lower terciles and taking into account the differences in the number of standard individuals between the terciles (in total, a difference of more than NIS 250 thousand per family per year), the increase of about 30 grams in the weight of newborns of parents in the upper tercile relative to the lower tercile is similar to that derived from the estimated coefficient of family income in Models 1 and 2 ([250 thousand] X [estimated coefficient = 0.0001]=25).

significant income disparities between the groups (for example, between non-ultra-Orthodox Jews and Bedouins in southern Israel).

Table 2 presents sensitivity tests for the effect of family income on birth weight. The results indicate that the estimated coefficients of family income remain basically unchanged (Models 2 to 4). The sensitivity tests included the omission of population groups (Model 2), which are correlated with family income; the restriction of the estimation to newborns up to order 4 (Model 3), which are common to all the population groups, since the higher orders are common in only some of the groups (primarily the ultra-Orthodox and Bedouins) and among families with special characteristics in the other groups (particularly among non-ultra-Orthodox Jews) which are likely to be correlated with weight; and the restriction of the estimation to newborns that do not weigh over 4,250 grams (Model 4) since according to the literature high birth weight is negatively correlated with life outcome variables.[21] Model 5 was estimated with fixed effects for the woman[22], which resulted in a large increase in explanatory power. This can be explained by the fact that fixed effects among the women (genetic/physiological, lifestyle, etc.) have a significant effect on birth weight. The estimated coefficient of income became insignificant in this case, which likely points to the effect of other factors that are correlated with income (such as smoking), or alternatively is an indication that the changes in family income for that woman over time are small relative to the differences in level of income between different women.

The sensitivity tests that restrict the estimation to newborns of up to order 4 or newborns that did not have a high birth weight were also performed for each of the population groups separately. The results are presented in Table A4 in Appendix A and show that the estimated effect of family income on birth weight remained unchanged. Due to the high correlation between age of the mother and birth order (0.7 among Bedouins in northern Israel and 0.85 among the ultra-Orthodox) estimations were performed for each of the population groups while including the age group of the woman as an explanatory variable instead of exact age, or omitting age altogether. In this case, the estimated coefficients of the other explanatory variables, including family income, remained almost unchanged (apart from the coefficients of birth order).

It should be emphasized that logit estimations performed for the probability of giving birth to a low weight newborn (weighing less than 2,500 grams) showed that the probability is not affected by family income, whether represented by a continuous variable or by terciles of family income per standard individual. Similar results were also obtained for the probability of a high birth weight (above 4,250 grams).

[21] It is conventional to define **high birth weight** (which is called macrosomia) as exceeding 4,000-4,500 grams or a weight above the 90th percentile of weight according to the stage of the pregnancy. The most common causes of high birth weight are the following: weight and height of the parents, and in particular the mother, a sharp increase in the mother's weight during pregnancy and a diabetic mother or a mother with gestational diabetes. The few studies worldwide that have examined the effect of high birth weight on outcome variables (for a review see Rashad and Cesur, 2008) found that there were negative effects on the child's health condition (particularly obesity), cognitive abilities and scholastic achievements, as well as his integration within the labor market.

[22] The random effects estimation did not succeed due to limits on computing power.

In the next stage, the effect of a change in family income on the change in birth weight for the same woman was analyzed. This involved examining whether the difference in weight between a high-order newborn and a lower-order newborn is influenced by changes in family income between the births (Table 3, left-hand side). In particular, a comparison was made between the weight of a fifth-order newborn and a third-order newborn for the same mother. The focus on fifth-order newborns has two main reasons: a) most of the families with 5 children are under the poverty line and therefore are sensitive to changes in income; and b) the number of sixth-order births and higher is small, which makes estimation difficult.[23] The choice of third-order newborns, rather than a lower order, is due to the fact that data was unavailable for birth weight prior to 1995. In addition, it is worthwhile that the birth interval not be too long, which would increase the chance of other factors changing as well. On the other hand, the interval should not be too short, in which case the changes in family income would not be large enough.

One of the explanatory variables included in the estimations was the weight of third-order newborns, which reflects the fixed effects of the woman such as genetic and physiological makeup, as well as other factors that probably do not change between the births of a third and a fifth child, such as years of schooling, lifestyle, etc., and which are likely to affect birth weight. Nonetheless, it is possible that other factors, such as the health status of the woman, do indeed change during this interval and affect both family income and birth weight. Thus, it cannot be determined with certainty that the findings presented below reflect a causal relationship between changes in family income and changes in birth weight.

It was found that an increase in family income between the third and fifth births had a positive and significant effect on the increase in the weight of a fifth-order newborn. Thus, among families in which the *change* in family income was in the upper tercile of the *distribution of income changes*, the increase in birth weight was higher by one percentage point (about 24 grams) than among families in the lower tercile, which represents more than one-third of the increase in weight.[24] The level of family income at the time of the birth of a third child also positively affected the weight of the fifth newborn, though this effect was also negligible. In order to test whether the contribution of changes in family income to the change in birth weight is dependent on income at the time of the third child's birth, separate estimations were carried out for families whose income at the time of the third child's birth was under the median and for other families. It appears that the coefficients of the tercile of change in family income were similar to those obtained in the consolidated estimation described above. A separate examination of population groups (Table 4) shows that an

[23] In estimations that were carried out nonetheless, the child allowance was not found to have any influence on the birth weight of sixth- and higher-order newborns.

[24] It should be remembered that birth weight naturally increases with birth order (see Figure 2 above). The weight increases by about 3.3 percent or about 57 grams.
The annual family income in the upper tercile of income growth increased by about NIS 73 thousand more than in the bottom tercile and therefore in theory every additional NIS 10 thousand in annual family income increases birth weight by about 3 grams. For purposes of comparison, Table 1 indicates that every NIS 10 thousand in family income is accompanied by an increase of about 1 gram in birth weight.

increase in family income between the third and fifth births had a positive and significant effect on the increase in birth weight, primarily among non-ultra-Orthodox Jews.

In contrast, changes in family income between the second and fourth births had no effect on the change in the fourth-order newborn's weight (Table 3, right-hand side) and similarly between other pairs of birth orders. Therefore, one cannot determine whether there is a causal relationship between changes in family income and changes in the weight of newborns of the same woman.

In addition, logit/probit estimations did not find a causal relationship between the probability of the birth of a fifth-order child at a weight less than the median (or less than 2,500 grams) and changes in family income between the third and fifth births, while controlling for the weight of the third child and the additional explanatory variables appearing in Table 3, both for girls and boys (not shown).[25]

The next stage involved testing for the effect of changes in the child allowance on birth weight in view of the fact it is an exogenous component of total family income, as opposed to, for example, changes in family income that are likely to have been the result of a third factor (such as the mother's health status) which also affects birth weight.[26]

The effect of the child allowance for a family with four children on the weight of fourth-order newborns was also tested. The focus on fourth-order newborns is due to the fact that changes in the child allowance over the years, and in particular the increase in child allowances during the 1990s for families that are not "military veterans" and the drastic cuts in the child allowance in 2003, primarily affected children of fourth and higher order (see Appendix B).[27]

The estimation included the weight of third-order newborns as a variable, which made it possible to control for the fixed effects of the mother and family, and the average weight of third-order newborns in the population who were born in the same year as the fifth child (hereafter: the trend), which was aimed at controlling for fluctuations that affect birth weight in the population as a whole (as a result of the business cycle, medical innovations and the like). In addition, a comparison was made to estimations that did not include the weight of third-order newborns nor the trend in weight. Note that the child allowances for first- and second-order children did not change over the years and therefore they cannot have any income effect on the weight of the third-order newborn.

Table 5 shows that the level of the annual child allowance for a family with four children is positively correlated with the weight of the fifth-order newborn. Thus, a NIS 10 thousand addition to family income is associated with an increase of about 25 grams (Model 3). It is worth mentioning that during the sample period, the average annual child allowance for a family with four children was NIS 14,300 (in 2007 prices). Thus canceling

[25] In similar estimations, no relation was found between the probability of the birth of a fifth-order child with a high birth weight (over 4,250 grams) and changes in family income between the births of the third and the fifth child.

[26] Nonetheless, changes in the size of the child allowance did affect fertility in a differential manner according to demographic/socioeconomic characteristics (Toledano et al., 2009) and those same characteristics may also affect birth weight.

[27] The average annual child allowance per family with four children was lower by about NIS 5,900 during the period 2004-7 (in 2007 prices) than during the period 1995-2003.

it completely would have in theory reduced the birth weight of a fifth-order newborn by more than 35 grams. The drastic cut in the child allowance in 2003 in theory reduced birth weight by about 18 grams. It should be mentioned that in other estimations, in which the weight of the third-order newborn was replaced by the weight of newborns of other orders, the estimated coefficients of the child allowance remained similar.

However, a placebo estimation also points to a positive correlation between the level of the annual child allowance for a family with four children and the weight of a *third-order* newborn, even though his weight is not meant to be affected by that child allowance but rather by the level of the child allowance for two children, which was stable during the sample period. Thus, it is possible that there exists another (unobservable) factor which is correlated with the size of the child allowance and which affects birth weight but is not reflected in the trend (the average weight of third-order newborns). One of the candidate variables is the macroeconomic environment and therefore the rate of unemployment was included as an explanatory variable. However, it was not significant and the coefficients of the trend and the annual child allowance for a family with four children remained almost unchanged. Other placebo estimations, which tested for the relation between the child allowance for four children and birth weight for other birth orders of less than 5, produced similar results to those obtained for the weight of a third-order newborn and were even more significant. Thus, we did not manage to determine whether the significant relation between the size of the child allowance for four children and birth weight for fifth-order newborns is causal (i.e. a result of the child allowance) or simply circumstantial (i.e. the result of another factor).

Finally, the effect of the increase in the child allowance, due to the cancellation of the military service criterion, on birth weight among the Bedouin in southern Israel was tested. This is a particularly important test since the effect of income on birth weight is expected to be relatively large for a poor population group such as the Bedouin. Moreover, the child allowance accounts for a significant portion of the Bedouins' income.

During the period from January 1995 until August 1996, the difference in the child allowance for the third child and above between "military veterans" and others (hereafter: the treatment group) was eliminated. As a result, the child allowance for most Bedouin families increased significantly and became equal to those of "military veterans", whose child allowances remained unchanged (see Appendix B). The families who are not "military veterans" can be considered a treatment group and the "military veterans" a control group and thus it is possible to test the effect of treatment using the difference-in-differences method.

In order to carry out the test, 4,210 Bedouin women were identified in the treatment group and 480 women in the control group. Table 6 presents the differences in birth weight before the treatment (1995–1996) and after (1998–2000),[28] in both the treatment and control groups. As a result of the treatment, the birth weight for women in the treatment

[28] The year 1997 was omitted from the table since some of the pregnancies among women who were not "military veterans" occurred before child allowances were equalized while others occurred afterward but may have still been affected by the smaller size of the child allowance that prevailed previously. Births that occurred after 2000 were not tested since there were significant changes in the size of the child allowance during that period.

group increased significantly (the first difference of the total is significant) and at the same time birth weight for women in the control group declined, though the decline was not significant. The difference in differences in birth weight (the right-hand column in the table) is positive though not significant, as was generally the case for the difference in differences according to birth order.

Estimations were performed for birth weight among Bedouins in southern Israel, such as that appearing in Table A4, which also included the following explanatory variables: a dummy for the treatment group, a dummy for the period following treatment and interaction between the two dummies. The results of the estimations (Table 7) indicate that the two dummy variables are not significant at all and the coefficient of the interaction term, which tests for the effect of the treatment on the treated, is positive but not significant.[29] The results obtained in the estimations are similar to those presented in Table 6 and are consistent with the findings presented earlier, which were also unable to prove that a causal relationship exists between the increase in family income and the increase in birth weight.

Similar tests of the effect on birth weight of the increase in child allowances as a result of the cancellation of the "military veteran" criterion were also carried out for Bedouins in northern Israel and Druze (not including those on the Golan Heights), both of which include both "military veterans" and others.[30] The estimations (not shown) indicate that the increase in child allowances had no significant effect on birth weight, which is in line with the findings above.

Table 8 summarizes the findings of the study. According to the two main findings, there is a clear positive correlation between the *level* of family income and birth weight, yet no causal relationship can be proven (though it was not disproved either). There are a number of factors that can explain this: a) The positive correlation is weak and large changes in family income are needed in order to produce significant changes in birth weight. b) The positive correlation between the level of family income and birth weight is partly the result of other factors (such as abstinence from smoking) which are correlated both with income and with birth weight. We believe that there is a causal relationship between family income and birth weight since some of results of the causality tests are positive; however, this relationship constitutes only a small part of the correlation (and therefore it was difficult for the causality tests to identify it). Even in cases where a causal relationship was found, it was weak in intensity and smaller than that presented in the literature as having a significant effect on life outcomes (see Table A1 in Appendix A).

[29] Similar results were also obtained in the binary estimations of the probability of a birth weight below 2,500 grams or a birth weight exceeding 4,250 grams.

[30] 1,316 Bedouin women in northern Israel (33 percent of whom had the status of "military veteran") and 2,395 Druze women (83 percent of whom had the status of "military veteran") were identified. During the period 1995-2000 (not including 1997), 1,873 Bedouins and 3,097 Druze were born, where the proportion of newborns with the status of "military veterans" was similar to the proportion of women with the status of "military veterans".

Table 1
Birth weight[1] correlates, 1995–2007 (grams)

		Model 1	Model 2	Model 3
Daughter		***-122.4 [1.1]	***-122.4 [1.1]	***-123.5 [1.2]
Age of woman (years)		***18.6 [1.0]	***20.0 [1.0]	***18.2 [1.0]
Age of woman squared		***-0.36 [0.02]	***-0.38 [0.02]	***-0.35 [0.02]
Family status (in comparison to married)	Single	***-35.8 [3.2]	***-35.6 [3.1]	***-38.2 [3.2]
	Divorced/widow	***-42.1 [5.8]	***-42.1 [5.8]	***-44.1 [5.8]
Family income[2] (NIS)		***1.0E-4 [7.0E-6]	***1.1E-4 [6.7E-6]	
Working mother[3]		***17.7 [1.4]		
Working spouse[3]		**-3.0 [1.49]		
Family income[2] per standard individual (NIS)	Middle tercile[4]			***7.0 [1.5]
	Upper tercile[4]			***29.4 [1.9]
Population group (in comparison to non-ultra-Orthodox Jews)	Ultra-Orthodox	***6.8 [2.2]	***9.9 [2.0]	***7.4 [2.2]
	Bedouin in the North	-5.7 [4.5]	**-10.4 [4.5]	*-7.7 [4.5]
	Bedouin in the South	***-121.6 [2.7]	***-128.3 [2.6]	***-121.4 [2.7]
	Jerusalem Arabs	***-53.9 [2.8]	***-62.7 [2.7]	***-53.5 [2.8]
	Other Arabs[5]	***15.8 [1.9]	***10.4 [1.9]	***14.9 [1.9]
	Druze	***28.4 [3.4]	***24.5 [3.4]	***25.8 [3.4]
Birth interval of less than 2 years		***-37.0 [1.5]	***-37.3 [1.5]	***-36.7 [1.5]
Birth order		V[6]	V	V
Constant		***2958.2 [13.7]	***2948.3 [13.7]	***2958.9 [13.7]
Number of observations		753,154	753,154	753,154
Adjusted R^2		0.05	0.05	0.05

Source: Ministry of Health, National Insurance Institute and calculations of the authors.
* significant at a level of 10 percent, ** significant at a level of 5 percent and *** significant at a level of 1 percent.
[1] Single births.
[2] Family income: Couple's annual salary income, income supplement and disability insurance during the year prior to the birth (in 2007 prices). Does not include families with self-employed income.
[3] During the previous year.
[4] Terciles of annual family income per standard individual for each population group and each year separately in comparison to the lowest tercile. In 2007, annual average family income per standard individual was as follows (NIS): 1,625 in the lower tercile; 13,509 in the middle tercile; and 54,837 in the upper tercile.
[5] Arabs who are not Bedouins or residents of Jerusalem (also does not include Druze).
[6] Coefficients of birth order (in comparison to birth order of 1, in grams): 2 – 128, 3 – 168, 4 – 202, 5 – 234, 6 – 263, 7 – 293, 8 – 324, 9 – 353, 10+ – 397.

Table 2
Sensitivity tests for the effect of family income on birth weight,[1] 1995–2007 (grams)

	Model 1 (Model 1 in Table 1)	**Model 2**	**Model 3** (up to birth order 4)	**Model 4** (up to a weight of 4250 grams)	**Model 5**
Family income[2] (NIS)	***1.0E-4 [7.0E-6]	***9.1E-5 [6.8E-6]	***9.8E-5 [7.3E-6]	***1.1E-4 [6.6E-6]	7.6E-6 [1.0E-5]
Working mother[3]	V	V	V	V	V
Working spouse[3]	V	V	V	V	V
Population group	V		V	V	V
Fixed effects of the woman					V
Number of observations	753,154	753,154	596,314	733,959	753,154
Adjusted R^2	0.05	0.05	0.04	0.05	0.71

Source: Ministry of Health, National Insurance Institute and calculations of the authors.
* significant at a level of 10 percent, ** significant at a level of 5 percent and *** significant at a level of 1 percent.
[1] Single births.
The following variables also appear in all the estimations: age of the woman, age of the woman squared, family status, birth interval of less than two years and birth order.
[3] Family income: the couple's annual income from salaries, income supplement and disability insurance during the year prior to the birth (in 2007 prices). Does not include families with self-employed income.
[3] During the previous year.

Table 3
The effect of changes in family income on birth weight[1]:
Weight of fifth/fourth-order newborn (later) in comparison to third/second-order newborn (earlier)

		Fifth-order newborn relative to third-order		Fourth-order newborn relative to second-order	
		Percentage points	Grams	Percentage points	Grams
Trend (average weight of earlier newborn in the population)		0.010 [0.010]	0.168 [0.206]	***0.014 [0.005]	***0.378 [0.094]
Weight of the earlier newborn (grams)		***-0.028 [0.000]	***-0.566 [0.005]	***-0.030 [0.000]	***-0.564 [0.004]
Rate of change in annual family income[2] between the births of the earlier and the later child[3]	**Lower tercile**	*****-1.047 [0.289]**	****-23.732 [6.233]**	**-0.094 [0.258]**	**-0.429 [5.248]**
	Middle tercile	**-0.297 [0.284]**	**-2.411 [6.117]**	**0.161 [0.258]**	**8.529 [5.238]**
Annual family income at the time of the birth of the earlier child (2007 prices, NIS)		***5.3E-6 [1.4E-6]	***8.8E-5 [3.1E-5]	6.1E-7 [1.2E-6]	2.9E-5 [2.5E-5]
Gender of the earlier and later newborns (in comparison to daughter-son)	Daughter-daughter	***-4.258 [0.303]	***-136.953 [6.739]	***-3.896 [0.287]	***-126.100 [5.821]
	Son-son	-0.285 [0.311]	-7.958 [6.704]	-0.184 [0.285]	***-58.934 [5.787]
	Son-daughter	***-4.110 [0.315]	***-133.132 [6.800]	***-4.202 [0.289]	***-186.890 [5.879]
Birth interval of less than 2 years		***-1.001 [0.065]	***-24.035 [1.378]	***-1.125 [0.217]	***-34.429 [4.414]
Age groups		V	V	V	V
Population group		V	V	V	V
Constant		**69.067 [31.678]	**1384.843 [682.900]	***55.166 [15.336]	***696.971 [311.445]
Number of observations		39,197	39,197	45,020	45,020
Adjusted R^2		0.283	0.270	0.317	0.300

Source: Ministry of Health, National Insurance Institute and calculations of the authors.
* significant at a level of 10 percent, ** significant at a level of 5 percent and *** significant at a level of 1 percent.
[1] Single births. Does not include Jerusalem Arabs or families with self-employed income.
[2] Family income: the couple's income from salaries, child allowance, income supplement and disability insurance.
[3] In comparison to the upper tercile of the rate of increase. The real rate of increase in family income (in the case of the fifth newborn relative to the third) in the lower tercile was up to 8.6 percent and in the upper third exceeded 77.9 percent.

Table 4
The effect of changes in family income on the increase in birth weight[1]: The fifth-order newborn relative to the third-order, according to population group

	Non-ultra-Orthodox Jews		Ultra-Orthodox		Bedouins in the South		Other Arabs[2]	
	Percentage points	Grams	Percentage points	Grams	Percentage points	Grams	Percentage points	Grams
Lower tercile of income relative to upper tercile	***-1.49	***-49.4	-0.61	0.6	*-1.53	-19.0	*-1.30	-23.2
Middle tercile of income relative to upper tercile	**-1.09	**-29.3	-0.12	11.6	-0.14	1.3	**-1.63	-15.4
Number of observations	10,978	10,978	14,105	14,105	5,310	5,310	7,676	7,676
Adjusted R^2	0.273	0.259	0.276	0.281	0.336	0.280	0.280	0.256

Source: Ministry of Health, National Insurance Institute and calculations of the authors.
* significant at a level of 10 percent, ** significant at a level of 5 percent and *** significant at a level of 1 percent.
[1] Single births. The estimations also include the variables appearing in Table 3: trend (average weight of third-order newborns), weight of the third-order newborn, annual family income at the time of the birth of the third child, gender of the third- and fifth-order newborns, birth interval of less than 2 years, age group and constant.
[2] Arabs who are not Bedouin or residents of Jerusalem (also not include Druze).

Table 5
Effect of the child allowance on the weight of a fifth-order newborn[1] (grams)

	Fifth-order newborn			Third-order newborn (placebo)
	Model 1	Model 2	Model 3	
Annual child allowance per family with four children (2007 prices, NIS)	***1.7E-3 [3.8E-4]	***2.5E-3 [4.6E-4]	***2.5E-3 [4.9E-4]	**2.2E-3 [1.0E-3]
Weight of third-order newborn[2] (grams)		***0.45 [0.00]	***0.45 [0.00]	***0.45 [0.01]
Trend (average weight of a third newborn)[3]			-0.05 [0.19]	0.04 [0.14]
Dummy for birth interval of less than 2 years	***-36.0 [4.03]	***-36.3 [4.47]	***-36.2 [4.48]	***-46.4 [6.50]
Gender of third and fifth children	V	V	V	V
Age group	V	V	V	V
Population group	V	V	V	V
Number of observations	81,932	45,347	45,347	21,560
Adjusted R^2	0.024	0.214	0.214	0.233

Source: Ministry of Health, National Insurance Institute and calculations of the authors.
* significant at a level of 10 percent, ** significant at a level of 5 percent and *** significant at a level of 1 percent.
[1] Single births. Does not include Jerusalem Arabs since there is no way to identify with certainty the families who received child allowances.
[2] Weight of the *second*-order newborn in the case where the dependent variable is the weight of the third-order newborn.
[3] Average weight of a third-order newborn at the time of the birth of the fifth-order child for each population group separately. The average weight of a *second*-order newborn in the population in the case where the dependent variable is the weight of the third-order newborn.

Table 6
Birth weight among Bedouin newborns in southern Israel, "military veterans" versus non-"military veterans", according to birth order[1] (grams)

Birth order	**Non-"military veteran"** (treatment)			**"Military veteran"** (control)			**Difference in differences**[3]
	1996–1995	1998–2000	Difference[2]	1995-1996	1998–2000	Difference[2]	
5	3,249	3,298	**50	3,291	3,153	*-138	**188
6	3,307	3,281	-27	3,306	3,308	2	-29
7	3,296	3,332	35	3,199	3,341	**142	-107
8	3,338	3,351	13	3,302	3,211	-91	105
9	3,327	3,392	*65	3,295	3,272	-23	88
10	3,312	3,435	**123	3,370	3,333	-37	160
Total[4]	**3,293**	**3,328**	***34	**3,285**	**3,278**	-7	**41**

Source: Ministry of Health, National Insurance Institute and calculations of the authors.
* significant at a level of 10 percent, ** significant at a level of 5 percent and *** significant at a level of 1 percent.
[1] Single births. Third- and fourth-order newborns and those over tenth-order are not shown due to the small number of observations.
[2] 1998–2000 less 1995–1996.
[3] Non-"military veterans" less "military veterans".
[4] Birth order 5–10 only.

Table 7
The effect of raising the child allowance for Bedouins in the south of the country who are not "military veterans" on birth weight[1] (grams)

	Model 1	**Model 2**
Dummy for the period following the increase in the child allowance	16.3 [11.5]	18.0 [11.6]
Dummy for non-"military veterans" (treatment group)	28.7 [26.2]	22.5 [18.0]
Dummy (following the increase in the child allowance x non-"military veterans")	36.9 [34.1]	39.0 [31.6]
Birth order, gender and birth interval of less than two years	V	V
Other control variables[2]		V
Number of observations	10,843	10,843
Adjusted R^2	0.03	0.03

Source: Ministry of Health, National Insurance Institute and calculations of the authors.
* significant at a level of 10 percent, ** significant at a level of 5 percent and *** significant at a level of 1 percent.
[1] Single births.
[2] The additional control variables appear in Table A4 in Appendix A for Bedouins in the South.

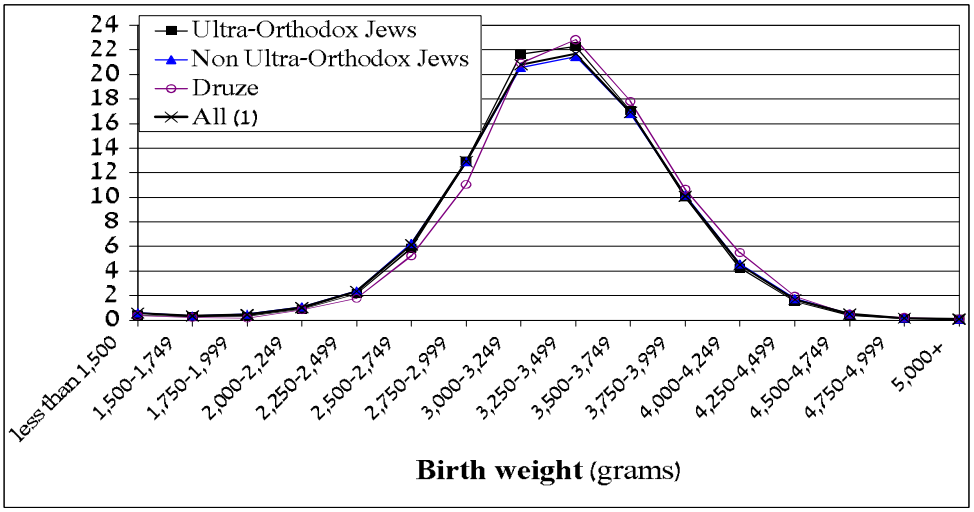
Table 8
Effect of income on birth weight: summary of research findings

Explanatory variable	Main findings	Comments
Family income level	Birth weight in families in the upper tercile of family income distribution is higher by about 30 grams than for families in the lower tercile. Equal to about 1 gram per NIS 10 thousand.	Endogeneity problem: other variables (such as smoking) are correlated with both family income and birth weight. For a given mother, this cannot be controlled for, except in one of the estimations (cluster for the woman), so there is no correlation.
Effect of a change in family income on birth weight for a given mother	An increase in family income leads to a significant increase in the weight of a fifth-order newborn relative to a third-order newborn for a given mother (about 3 grams for every NIS 10 thousand). In contrast, no significant increase was found for the transition from order 2 to order 4.	Possibility of endogeneity: changes in other variables (such as medical situation) are likely to bring about a change in the same direction both in family income and in birth weight. Controlled for a given mother.
Change in the size of the child allowance	An increase in the size of the child allowance leads to a significant increase in the weight of a fifth-order newborn while controlling for the weight of the third-order newborn for the same mother (about 3 grams per NIS 10 thousand). In contrast, a placebo test also indicated a significant increase.	There is no possibility of endogeneity. Controlled for a given mother.
An increase in the child allowance for part of the Bedouin and Druze populations (the treated population: non-"military veterans")	The increase in the child allowance for treated Bedouins in southern Israel led to a significant increase in birth weight though the increase was not significant relative to the control group. No effect was found for treated Bedouins in the North or for treated Druze.	There is no possibility of endogeneity. There is no control for a given mother. The control group among the Bedouin and the treatment group among the Druze are relatively small and therefore it is difficult to obtain significant results.

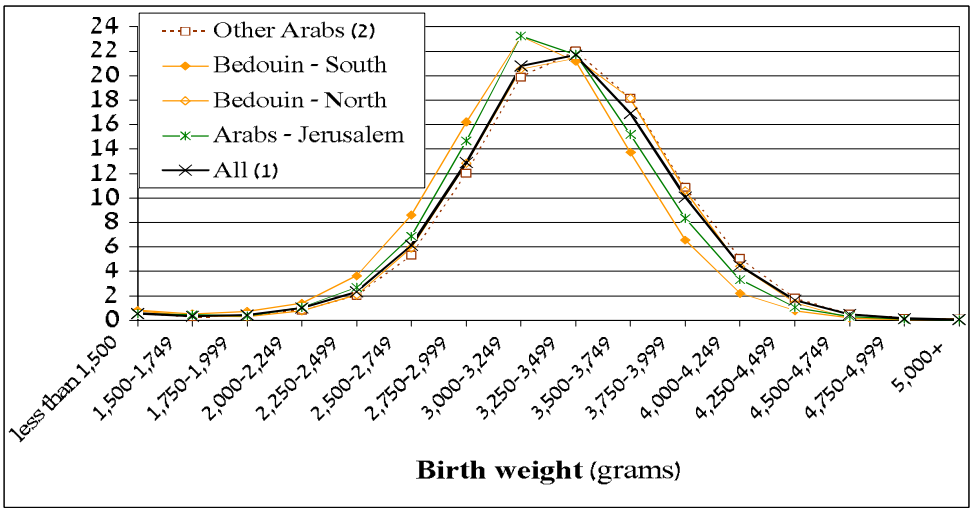
APPENDICES
Appendix A: Graphs and Tables

Figure A1
Distribution of birth weight in third-order single births according to population group, 1995–2007

a. Jews and Druze



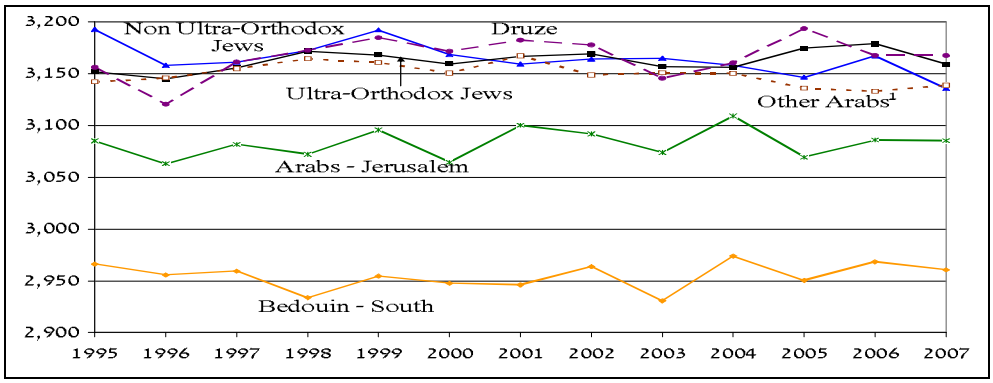
b. Arabs



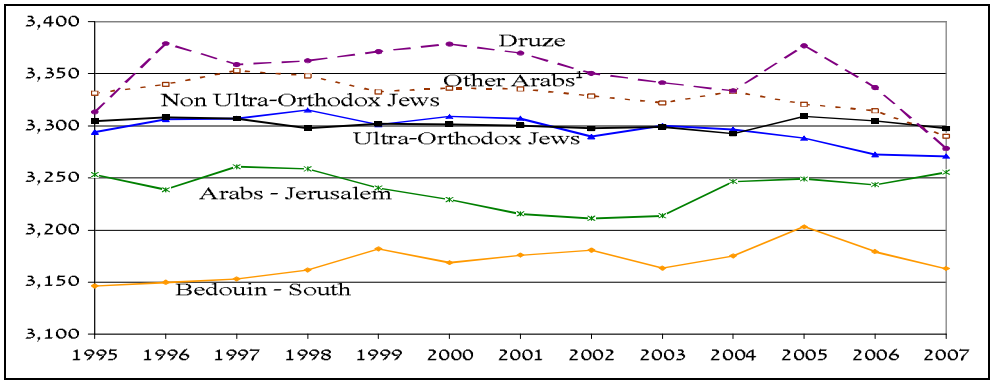
Source: Ministry of Health, National Insurance Institute and calculations of the authors.
[1] The whole population: Jews and non-Jews (including Druze).
[2] Arabs who are not Bedouin or residents of Jerusalem (also not including Druze).

Figure A2
Average birth weight in single births according to population group and birth order, 1995–2007 (grams)

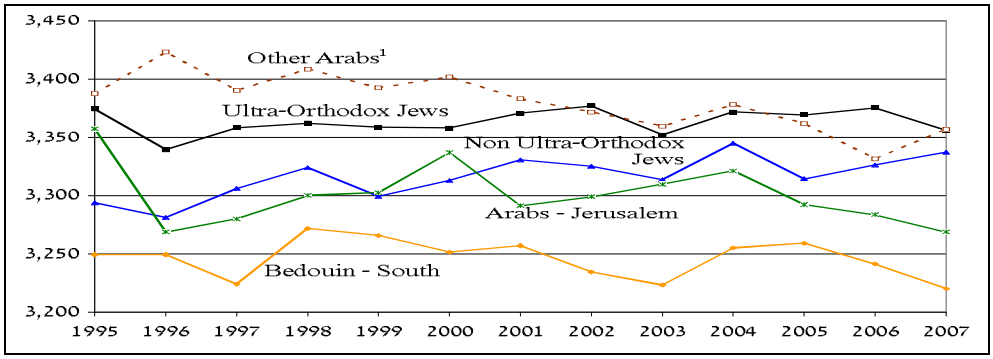
a. birth order 1



b. birth order 3

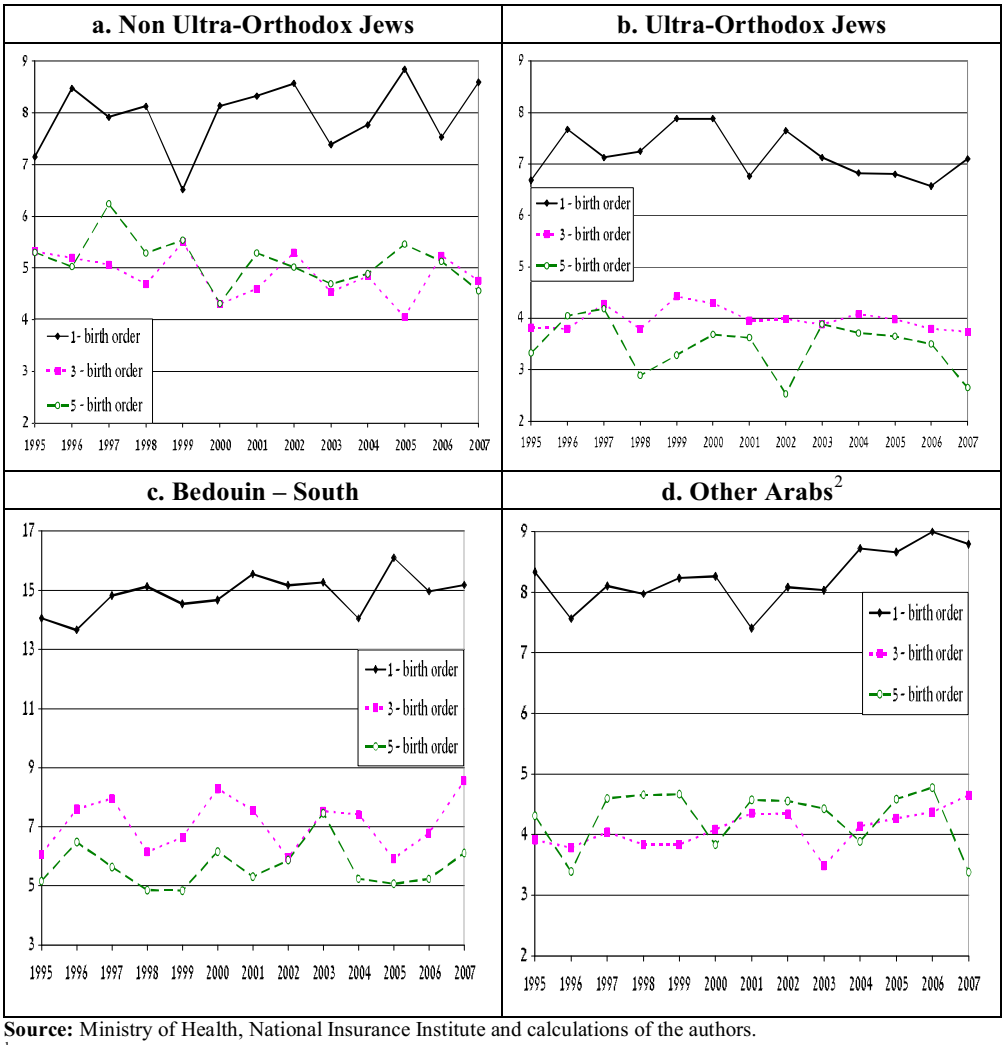


c. birth order 5



Source: Ministry of Health, National Insurance Institute and calculations of the authors.
[1] Arabs who are not Bedouin or residents of Jerusalem (also not including Druze).

Figure A3
Proportion of low weight newborns[1] in single births according to population group and birth order, 1995–2007 (percent)



Source: Ministry of Health, National Insurance Institute and calculations of the authors.
[1] Less than 2500 grams.
[2] Arabs who are not Bedouin or residents of Jerusalem (also not including Druze).

Table A1
The effect of birth weight on outcome variables: main results in the literature

Source	Infant mortality (first year)	Mortality at age 1–17	Newborn health status APGAR	Height	Height-weight (BMI)	IQ	Completion of high school on time	Fulltime employment	Labor income	Receipt of government assistance	Weight of first child
Black et al. (2007): increase of 10 percent in weight	-15 percent (4.5 babies per 1000 newborns)			0.4 percent (0.57 cm.)	0.5 percent (0.11)	12 percent (0.62 on a scale of 1 to 9)	12 percent (0.9 percentage points)	No effect	1 percent		1.5 percent
Almond et al. (2005): increase in weight of one standard deviation (667 grams)	0.08 of a standard deviation		0.03 of a standard deviation								
Oreopoulos et al. (2008): newborns weighing 1,500-3,500 grams relative to newborns weighing more than 3,500 grams	0.4-6.3 percent (siblings); no effect among twins	0.7 percent (1,500 to 2,500 grams, siblings); no effect among twins	No increase in number of visits to a physician from age 12 to 17			No difference in achievements on English knowledge exams.	-2–13 percent			No effect among siblings; 10 percent among twins	
Royer (2009): increase of 1,000 grams	-33 percent (2.2 babies per 1,000 newborns)						1.2 percent in years of schooling (0.16 school years)				2.1 percent (70 grams)
Behrman and Rosenzweig (2004): average increase of 28.3 grams (1 oz.) in weight per week of pregnancy				2.3 percent (3.8 cm.)	No effect		5.1 percent (0.7 years of schooling)		0.4 percent		
Del Bono and Ermisch (2009): increase of 1000 grams						About 0.2 standard deviations in vocabulary test at age 3; no effect at age 5					
Currie and Moretti (2007): low birth weight							-0.1 years of schooling		4 percent for residence in a poor area		50 percent for low weight

Table A2
Average birth weight[1] by population group, gender and birth order, 1995–2007 (grams)

		Jews			Arabs					Druze
Birth order	Total	Total	Non-ultra-Orthodox	Ultra-Orthodox	Total	Bedouin in the South	Bedouin in the North	Jerusalem	Other Arabs[2]	
	Boys									
1	3,209	3,222	3,222	3,218	3,163	3,000	3,150	3,136	3,201	3,220
2	3,330	3,339	3,342	3,316	3,295	3,147	3,311	3,232	3,336	3,353
3	3,357	3,357	3,354	3,370	3,353	3,227	3,354	3,302	3,392	3,419
4	3,376	3,372	3,361	3,404	3,379	3,269	3,402	3,344	3,416	3,457
5	3,403	3,402	3,382	3,431	3,400	3,301	3,448	3,367	3,447	3,475
6	3,421	3,429	3,399	3,457	3,407	3,323	3,445	3,372	3,473	3,505
7	3,442	3,449	3,424	3,465	3,429	3,374		3,418	3,484	
8	3,468	3,488	3,469	3,496	3,426	3,388		3,443	3,464	
9	3,488	3,509		3,510	3,442	3,394		3,496	3,513	
10	3,506	3,522		3,523	3,465	3,438			3,512	
+11	3,505	3,518		3,521	3,467	3,449			3,543	
	Girls									
1	3,094	3,103	3,102	3,106	3,060	2,906	3,068	3,029	3,096	3,110
2	3,204	3,214	3,217	3,189	3,169	3,043	3,185	3,108	3,206	3,227
3	3,233	3,233	3,234	3,230	3,227	3,111	3,244	3,175	3,263	3,275
4	3,251	3,248	3,240	3,268	3,255	3,156	3,246	3,207	3,295	3,291
5	3,270	3,267	3,248	3,294	3,268	3,186	3,313	3,233	3,310	3,382
6	3,294	3,298	3,270	3,322	3,287	3,218	3,369	3,266	3,332	3,362
7	3,315	3,325	3,294	3,346	3,293	3,237		3,276	3,354	
8	3,339	3,352	3,326	3,364	3,311	3,257		3,339	3,376	
9	3,358	3,374		3,385	3,319	3,296		3,370	3,334	
10	3,365	3,385		3,413	3,313	3,291			3,332	
+11	3,387	3,400		3,410	3,349	3,302			3,447	
	Proportion of first-order newborns with weight of less than 2,500 grams (percent)									
Boys	7.6	6.9	7.2	6.4	8.6	13.7	8.3	8.2	7.8	6.4
Girls	9.0	8.4	8.7	8.0	9.9	16.2	10.2	10.0	8.7	7.2
	Proportion of first-order newborns with weight of less than 1,500 grams (percent)									
Boys	1.0	0.9	0.9	0.9	1.2	1.7	1.4	1.1	1.2	0.6
Girls	1.0	0.9	1.0	0.8	1.1	1.5	1.5	0.9	1.1	0.9
	Proportion of first-order newborns with weight of *more* than 4,000 grams (percent)									
Boys	4.6	4.9	5.0	4.2	3.8	1.5	3.0	2.7	4.5	4.0
Girls	2.2	2.3	2.3	2.0	1.8	0.6	1.5	1.2	2.1	1.6
	Proportion of first-order newborns with weight of *more* than 4,500 grams (percent)									
Boys	0.5	0.5	0.5	0.3	0.3	0.2	0.3	0.2	0.4	
Girls	0.2	0.2	0.2	0.1	0.2	0.1	0.1	0.2	0.2	

Source: Ministry of Health, National Insurance Institute and calculations of the authors.
[1] Single births.
[2] Arabs who are not Bedouin or residents of Jerusalem (also not including Druze).

Table A3
Economic characteristics by population group and birth weight—boys,[1] 1995–2007

	Birth weight[2] (grams)	Non-ultra-Orthodox Jews			Ultra-Orthodox			Bedouins in the south			Other Arabs[3]		
		Order 1	Order 3	Order 5	Order 1	Order 3	Order 5	Order 1	Order 3	Order 5	Order 1	Order 3	Order 5
Proportion of working husbands[4] (percent)	Less than 2500	83	86	81	21	27	32	62	63	54	84	84	81
	2500 to average	85	88	79	20	28	28	64	64	61	87	85	80
	Above the average	88	88	80	20	27	30	70	66	62	88	87	83
Proportion of working mothers[4] (percent)	Less than 2500	89	76	59	79	73	56	23	14	9	51	35	20
	2500 to average	89	81	63	81	75	58	22	15	10	52	34	22
	Above the average	88	83	65	81	76	60	27	19	13	54	37	23
Annual salary of husband[5] (NIS thousand, 2007 prices)	Less than 2500	86.7	122.0	98.8	24.8	35.7	51.8	33.2	40.8	47.4	45.0	53.7	51.8
	2500 to average	89.4	126.8	103.6	23.3	42.2	51.3	34.2	41.2	48.2	46.8	51.4	50.7
	Above the average	88.4	133.5	113.1	23.7	41.5	52.2	36.1	44.0	47.9	48.9	55.0	53.8
Annual salary of mother[5] (NIS thousand, 2007 prices)	Less than 2500	47.4	45.5	36.7	19.2	27.1	37.0	14.6	21.5	17.6	17.5	23.8	17.9
	2500 to average	47.6	52.2	38.0	18.5	28.8	37.5	14.4	20.8	19.2	17.6	23.6	18.1
	Above the average	47.1	56.0	42.6	18.8	29.9	38.4	17.2	22.8	20.6	19.3	26.4	20.6
Annual salary of couple[5] (NIS thousand, 2007 prices)	Less than 2500	114.2	136.6	99.9	24.3	33.1	41.4	27.4	29.2	29.3	47.7	52.0	43.5
	2500 to average	118.7	147.6	103.4	23.5	36.9	38.4	27.6	31.5	30.9	51.1	51.1	51.8
	Above the average	117.5	157.1	112.9	23.6	37.4	40.9	32.3	35.9	35.0	54.1	55.8	47.2
Proportion receiving income supplement[6] (percent)	Less than 2500	7	7	12	2	4	4	27	32	41	13	17	23
	2500 to average	6	5	10	2	3	3	27	33	37	12	16	21
	Above the average	5	4	8	2	3	3	24	30	33	10	14	19

Source: Ministry of Health, National Insurance Institute and calculations of the authors.
[1] Single births.
[2] Average weight: according to population group, birth order and gender (see Table A2).
[3] Arabs who are not Bedouin or residents of Jerusalem (also not including Druze).
[4] Rate of employment in the year previous to the birth.
[5] Annual average salary in the year of the birth and the two years preceding it, for those who had a positive salary.
[6] Some of the ultra-Orthodox are not eligible for an income supplement due to the fact that they receive an income supplement as yeshiva students from the Ministry of Education.

Table A4
The factors that affect birth weight,[1] by population group, 1995–2007 (grams)

		Non-ultra-Orthodox Jews	Ultra-Orthodox Jews	Bedouins in the South	Other Arabs[2]
Daughter		***-122.3 [2.4]	***-127.5 [2.0]	***-112.2 [3.8]	***-122.8 [2.0]
Family status	Single	***-38.7 [5.2]	***-76.7 [9.5]	***-18.3 [5.8]	***-29.4 [8.9]
	Divorced widow	***-66.3 [7.1]	***-104.5 [26.6]	12.4 [15.5]	***-62.2 [12.6]
Family income[3] (NIS, 2007 prices)		***6.8E-5 [7.5E-6]	***1.1E-4 [1.8E-5]	***2.8E-4 [5.0E-5]	***2.2E-4 [1.9E-5]
Working mother[4]		***13.1 [2.3]	***15.8 [2.0]	***31.1 [5.2]	***15.4 [2.0]
Working spouse[4]		-0.29 [1.9]	**-4.6 [2.1]	***23.1 [3.1]	***23.5 [1.5]
Continent of origin (in comparison to native Israelis)	Europe	***59.8 [5.4]	***34.4 [5.7]		
	America	***46.2 [7.6]	***35.3 [5.8]		
	Asia	**-24.7 [11.8]	-17.6 [17.1]		
	Africa	-3.6 [8.7]	***47.6 [10.2]		
Immigrant (since 1989)		***39.4 [5.6]	2.9 [5.9]		
Ultra-Orthodox by narrow definition[5]			***10.6 [4.1]		
Recognized settlements				***43.2 [4.0]	
Birth interval of less than two years		***-33.1 [3.6]	***-21.9 [2.5]	***-44.0 [4.5]	***-44.2 [2.5]
Age group[6]		V	V	V	V
Birth order		V	V	V	V
Constant		***3158.1 [32.1]	***3027.8 [28.6]	***2952.6 [7.9]	***3137.7 [8.4]
Number of observations		184,190	228,065	72,587	257,583
Adjusted R^2		0.04	0.05	0.08	0.05

Source: Ministry of Health, National Insurance Institute and calculations of the authors.
* significant at a level of 10 percent, ** significant at a level of 5 percent and *** significant at a level of 1 percent.
[1] Single births.
[2] Arabs who are not Bedouin or residents of Jerusalem (also not including Druze). The estimation includes districts.
[3] Annual income: the couple's annual income from salary, income supplement and disability insurance during the year prior to the birth (2007 prices).
[4] In the previous year.
[5] A woman who studied/is studying in an ultra-Orthodox seminary and/or a woman who is married to a man who studied/is studying at a yeshiva and did not serve in the army or served less than one year.
[6] Dummy variables for age groups: 20–24, 25–29, 30–34, 35-39, and 40–44 (15–19 was omitted).

Table A5
Smoking patterns among mothers aged 21–44 by population group and income (proportions, percent)

		Non-ultra-Orthodox Jews	Ultra-Orthodox	Arabs[1]
Smokers	Total[2]	27	3	4
	Family income: under the median[3]	24		
	Family income: above the median[3]	19		
	Over 10 cigarettes per day	47		
Smoked in the past[4]		20	5	7

Source: Central Bureau of Statistics, National Health Survey 2003/4 and calculations of the authors.
[1] Arabs who are not Bedouin or residents of Jerusalem (also not including Druze).
[2] According to data of the Ministry of Health (Ministry of Health, 2009a), the proportion of smokers among women aged 21 and over in 2004 was as follows (percent): 21.3 for Jews and 8.3 for non-Jews.
[3] Median family income of non-ultra-Orthodox Jews. Not calculated for ultra-Orthodox and Arabs due to the small number of observations (and similarly for smokers of more than 10 cigarettes per day). The values are not a weighted average of the total in a group since some of the respondents did not report their income.
[4] Non-smokers at the time of the survey.

APPENDIX B: THE SIZE OF THE CHILD ALLOWANCE AND CHANGES IN LEGISLATION[1]

The child allowance is paid according to the National Insurance Law to families in Israel in order to assist them in the financing of childrearing expenses for children up to the age of 18. During the sample period (i.e. 1995–2007), there were a number of major changes in the child allowance system. During the period from January 1994 until August 1996, the differentiation that was made for many years in the size of the child allowance for the third child and above between "military veterans" (including Jews who had received an exemption from military service) and others, most of whom were Arabs[2], was cancelled and the child allowances for the latter thus increased.

In January 2001, an amendment to the National Insurance Law (also known as the "Halpert Law" after its initiator) went into effect, significantly increasing the child allowance for the fifth child and above. Thus, for example, the child allowance for a family with 7 children grew from NIS 3,558 in December 2000 to NIS 4,415 in January 2001 (in 2007 prices) (see Figure B1). This increased the proportion of the child allowance in such a family's income from about 38 percent to about 45 percent (Figure B2).

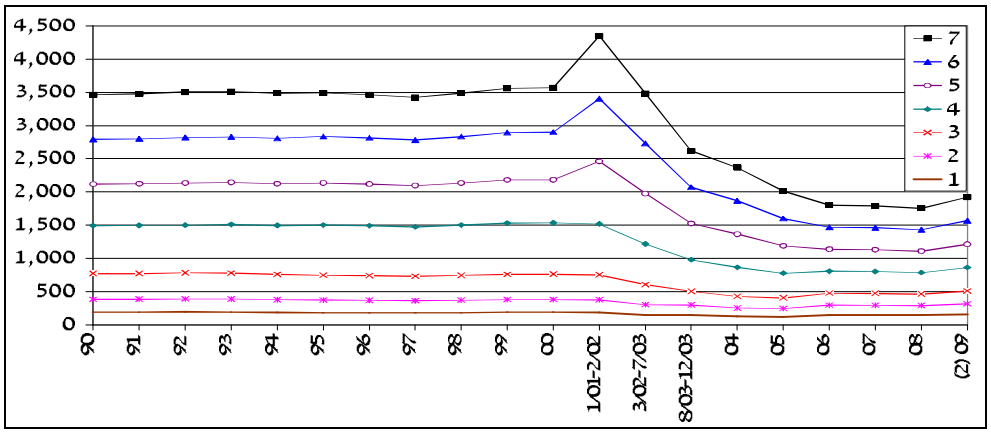
During the years 2002–3, there was a shift in welfare policy and the child allowance was cut drastically. The most significant change in the structure of the child allowance was made as part of the Economic Recovery program in June 2003. Within this framework, the child allowance for a child born until May 2003 ("old") would gradually be reduced and the

[1] For further details, see Toledano et al. (2009).
2 By way of illustration, in December 1993, just before the change in the legislation, the "military veteran" allowance for a third child (sixth and higher) was NIS 383 (672), at average 2007 prices, compared with an allowance of NIS 240 (240) for other children.

child allowance for a child born from June 2003 onward ("new") would immediately be equal to that for the first child, regardless of his birth order.

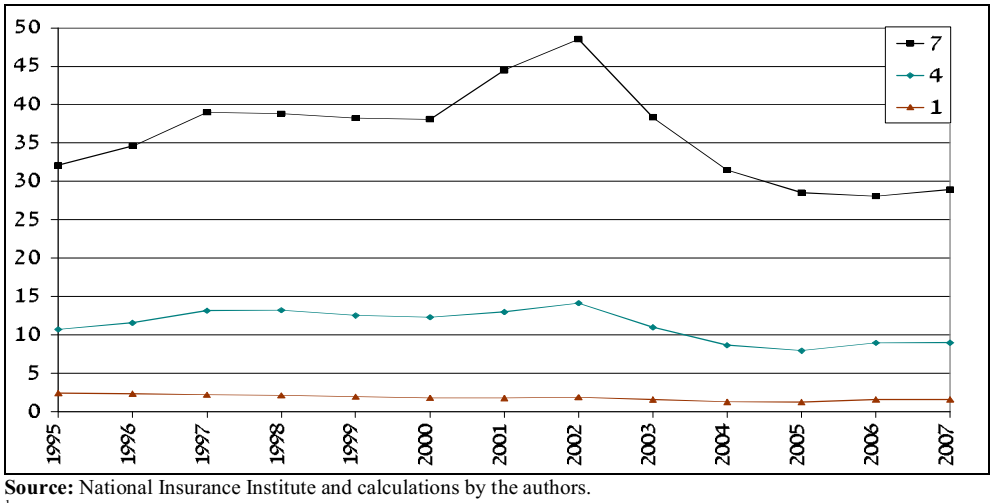
These latter changes in the law led to a sharp reduction in the level of the child allowance for the third-order child and above. For example, the child allowance of a family with seven "old" children, which stood at NIS 3,558 per month at the end of 2000 (about 38 percent of family income), plummeted to NIS 1,755 at the end of 2007 (about 29 percent of family income) and to NIS 1,016 if the children were "new". The sharp cut in the child allowance was especially felt by poor families who depend on the child allowance, a relatively high proportion of whom were ultra-Orthodox and Arab families (Figure B3).

Figure B1
Child allowances[1] per family, according to number of children
(NIS per month in average 2007 prices)



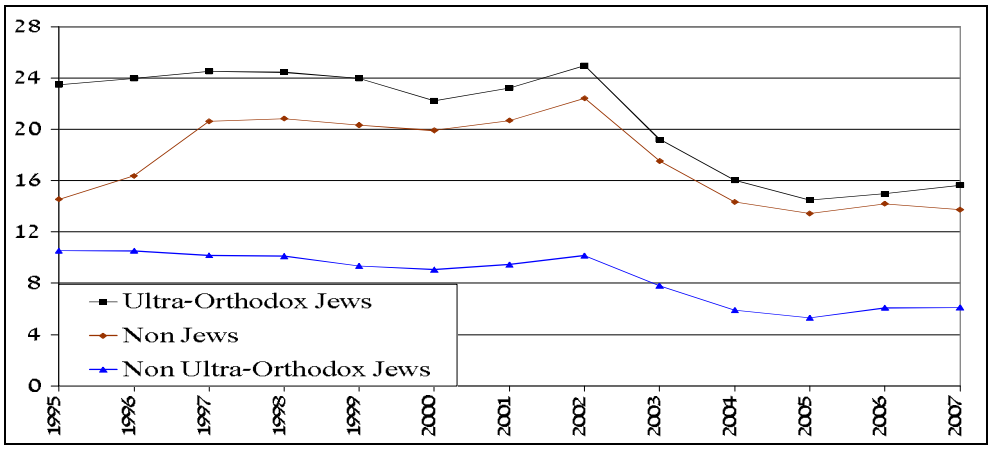
Source: National Insurance Institute and calculations by the authors.
[1] Including the "military veteran" child allowance. For children born up to June 2003.
[2] Not including an addition to the child allowance for birth order 2–4 as part of the Economic Efficiency Law for 2009–10 (the Arrangements Law).

Figure B2
Child allowances[1], per family relative to its income[2], according to number of children (percent)



Source: National Insurance Institute and calculations by the authors.
[1] For children born up to June 2003.
[2] Family income from salary, the child allowance, income supplement and disability insurance for a family of 2 adults (woman aged 15–44) and according to the number of children (up to the age of 18) indicated in the graph. Not including families with a self-employed earner.

Figure B3
The child allowance[1] per family with four children relative to its income[2] by population group (percent)



Source: National Insurance Institute and calculations by the authors.
[1] For children born up to June 2003.
[2] Family income from salary, the child allowance, income supplement and disability insurance for a family of 2 adults (woman aged 15–44) and 4 children (up to the age of 18). Not including families with a self-employed earner.

APPENDIX C: POSSIBLE CAUSES OF LOW BIRTH WEIGHT AMONG BEDOUINS IN SOUTHERN ISRAEL WITH EMPHASIS ON CLOSE-KIN MARRIAGES

Low birth weight among the Bedouin in southern Israel[1], a particularly poor sector of the population, appears to contradict the findings reached in the body of the study, according to which income has only a negligible effect on birth weight. Apart from genetic factors, two main explanations can be proposed to explain the finding: a high rate of close-kin marriages and difficult living conditions in the unrecognized settlements, both of which are correlated with a low level of income.

Birth weight among the Bedouin in unrecognized settlements is 43 grams lower than that of similar newborns whose parents live in permanent settlements (Table A4). This is likely to be the result of a low level of access to health services and the lack of other basic infrastructure (such as electricity and running water).[2] Since the proportion of Bedouins living in unrecognized settlements in southern Israel stood at about 45 percent on average during the sample period,[3] the effect of residence in an unrecognized settlement on average birth weight among the Bedouin in southern Israel is about 20 grams.

With regard to close-kin marriages, most studies show that they reduce birth weight, where the estimates range from a reduction of tens of grams to a reduction of about 200 grams (see the review of the literature in Mumtaz et al. (2007)). In Israel, Jabel et al. (1997) found that the birth weight of Arab newborns with parents who are cousins is 110 grams less than that of newborns with unrelated parents and the difference was found to be significant.

The phenomenon of close-kin marriages is widespread among the Bedouin in southern Israel, though it is also common among other non-Jewish populations. Thus, for example, a relatively small-scale survey carried out in 1990–2 found the following rates of close-kin marriage: 60 percent among the Bedouin (24 percent were cousins or closer); 47 percent among the Druze; 37 percent among Muslims (apart from Bedouins); and 22 percent among Christian Arabs (Vardi-Saliternik et al., 2002).[4] Based on a large survey carried out by the Galilee Foundation in 2004, Abu-Bader and Gottlieb (2008) found that the rate of close-kin marriages in Arab society was as follows (percentage of cousins in parenthesis): 61 (34) percent among the Bedouins; 29 (14) percent among the Druze; 36 (20) percent among Muslims (not including Bedouins); and 19 (11) percent among Christian Arabs. The parallel data for Bedouins in southern Israel showed a rate of 64 (37) percent and rates were somewhat higher in unrecognized settlements. Based on a large survey carried out in 2003–5 among Bedouin in southern Israel, Ben Rabi et al. (2009) found that the rate of close-kin

[1] The low birth weight among the Bedouin in southern Israel is consistent with findings that the health condition of Bedouin babies and children up to the age of 6 in southern Israel, particularly in unrecognized settlements, is significantly inferior to that of Jews (Ministry of Health, 2008).
[2] See Abu-Bader and Gottlieb (2008).
[3] Fertility is very similar in recognized and unrecognized settlements (Toledano et al., 2009).
[4] In comparison to the 1960s, there has been a significant drop in the rates of close-kin marriage among the Arab population (Jaber et al., 2000).

marriages (between cousins) among mothers with children aged 0–17 stood at 58 (27 percent).

In order to test the effect of close-kin marriages on birth weight among Bedouins in southern Israel, marriages between cousins were identified in the Population Registry according to the grandmothers[5] of mothers giving birth and those of their spouses.[6] In total, only about 10 percent of grandmothers were identified due to the lack of records in the Population Registry. Only about 200 married cousins were identified with certainty and they accounted for 588 out of about 62 thousand Bedouin newborns.[7]

The weight of newborns born to couples who were identified as cousins with certainty was 3,003 grams on average, which was lower than the average of 3,160 grams for other couples. The estimation results for birth weight among Bedouins in southern Israel[8] (not shown) indicate that the weight of newborns identified with certainty as being born to cousins was significantly lower (by 86 grams) than other similar newborns (with regard to birth order, gender, etc.) for whom it was not possible to determine with certainty whether or not their parents are cousins. It is possible to estimate the effect of marriages between cousins on birth weight among Bedouins in southern Israel using data on the proportion of newborns born to cousins. Thus, according to the survey of the Galilee Foundation carried out in 2004, this rate stood at 37 percent in 2004 (Abu-Bader and Gottlieb, 2008). Thus, the weight of newborns with parents who are cousins is lower by about 136 grams than that of newborns with parents who are with certainty not cousins (86/(1-0.37)=136). It turns out, therefore, that marriages between cousins reduce average birth weight among Bedouins in southern Israel by about 50 grams on average. Together with the reduction of about 20 grams due to residence in an unrecognized settlement, this explains about one-half of the gap in birth weights between Bedouins in southern Israel and non-ultra-Orthodox Jews.

[5] The analysis relates to the identification of cousins according to the grandmother for two reasons: the proportion of grandmothers who were identified was much higher than that of grandfathers due to, among other reasons, the high incidence of polygamy, which is prohibited by law and results in mothers not reporting their marriages. Due to polygamy, even if cousins on the grandfather's side are identified it is not clear whether the couple has a common grandmother.

[6] The test was not carried out for the Druze due to their small population. In addition, some of them live on the Golan Heights which was annexed to Israel and this creates further difficulty in identifying the grandfathers and grandmothers of the mothers and their spouses.

[7] The number of married couples identified with certainty as not being cousins is negligible.

[8] Estimations such as these are shown in Table A4 in Appendix A, with a dummy for a certain close-kin marriage as an additional explanatory variable.

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