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Emerging Early Childhood Inequality: Poverty and Future Academic Achievement

Dana Vaknin, Yossi Shavit, and Isaac Sasson

This paper was generously supported by the Bernard van Leer Foundation

Policy Paper No. 06.2019

Jerusalem, October 2019

Taub Center for Social Policy Studies in Israel

The Taub Center was established in 1982 under the leadership and vision of Herbert M. Singer, Henry Taub, and the American Jewish Joint Distribution Committee. The Center is funded by a permanent endowment created by the Henry and Marilyn Taub Foundation, the Herbert M. and Nell Singer Foundation, Jane and John Colman, the Kolker—Saxon—Hallock Family Foundation, the Milton A. and Roslyn Z. Wolf Family Foundation, and the American Jewish Joint Distribution Committee.

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Internet edition

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Abstract

Average academic achievement in Israel is among the lowest in the OECD and inequality in academic achievement is among the highest. Similarly, economic inequality and the incidence of poverty in Israel, particularly among children, are among the highest in the developed world. This study looks at whether and how household income in early childhood (from birth to age 5) affects later academic achievements on standardized tests. The study is based on the Population and Housing Census conducted in Israel in 1995 and 2008, which includes information on family income and socioeconomic background. Data on children's achievements on the Meitzav exams in Grade 5 (Meitzav is the Hebrew acronym for School Growth and Efficiency) were also used. The findings show that being at the lower end of the family income distribution in early childhood has an adverse and statistically significant effect on future academic achievement, even when controlling for household income in later childhood and other sociodemographic variables, such as parents' education and family size.

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This paper is based in part on a thesis paper by Dana Vaknin (2019), written under the guidance of Professor Yossi Shavit and Dr. Isaac Sasson, Department of Sociology and Anthropology, Tel Aviv University. The authors wish to thank Professor Avi Weiss and Professor Alex Weinreb for their helpful comments. The authors are also grateful to the Bernard van Leer Foundation for its generous support of this research project.

Also, there are substantial differences between stages of early childhood and the effect of family income on future academic achievement. The effect of relative poverty was found to be stronger for young children between birth and two years of age than for those between 3 and 5-years-old. These findings support "The First Thousand Days" theory, according to which early childhood should not be viewed as a single uniform unit but rather greater attention should be given to the first thousand days of life, which are critical to a child's future development.

Introduction

The early years of an individual's life are considered to be a highly important stage. The conventional wisdom is that if there is investment in the early years of childhood, then children will experience optimal development, will achieve greater success in school and in their adult lives, and will be better able to realize their full potential. In recent years, thanks to the development of the brain sciences and the development of advanced, non-invasive research tools such as MRI and fMRI, which make it possible to measure the activity of children's brains, this theory has been supported by research findings (Lenroot and Giedd, 2006). By means of such technological tools, researchers have found that, during early childhood, the environment and accessibility of learning and enriching experiences have a major impact on the development of the structure of the young brain (Rosenzweig, 2003; Lupien, McEwen, Gunnar & Heim, 2009; Noble et al., 2015).

This paper discusses the link between family income during early childhood — which is a critical age developmentally — and academic achievement in later years for Israeli children. It is known that the average academic achievements of students in Israel are among the lowest of those countries participating in international tests such as PISA and TIMSS. In addition, it is known that achievement gaps among students in Israel are among the highest in the OECD (RAMA, 2016). This paper will examine the question of whether the high variance in academic achievement among Israeli students is also related to the high levels of economic inequality and poverty among children. The literature on the unique effect of poverty at a young age on future achievement indicates that poverty is related to elevated levels of stress, low levels of positive stimulation, low parental investment in the cognitive development of their children, and the relatively low quality of early childhood education (Brooks-Gunn and Duncan, 1997; Guo, 1998). These factors are likely mediating variables of the negative effects of poverty on child development .

1. Economic inequality and poverty among children in Israel

Disposable income economic inequality in Israel is among the highest in the OECD countries. The share of households under the poverty line in Israel is higher than in any other developed country (Gal, Krumer-Nevo, Madhala, & Yanay, 2018). According to the Report on Poverty and Social Gaps of the National Insurance Institute (NII), in 2017, there were 466,400 families living in poverty in Israel, which included 814,800 children (NII, 2018). In an international comparison, the rate of poverty was 19.5 percent in Israel in 2015, the highest among the 32 OECD countries that were examined (Figure 1).[1] Not only is Israel's incidence of poverty the highest among developed countries, the problem is particularly acute in the case of children, where the rate of poverty for the 0 to 17 age group is 25.5 percent (OECD, 2016c).

According to the OECD definition, the incidence of poverty measured by disposable income among children in Israel was 23.8 percent in 2017. Thus, Israel is again high in the OECD ranking, with only Turkey having a higher incidence of poverty among children. According to the Israeli equivalence scale, the incidence of poverty in 2017 stood at 29.6 percent after transfer payments and direct taxes. This is compared to the per capita incidence of poverty which stood at 21.2 percent, 18.4 percent among families, and 17.2 percent among the elderly (NII, 2018).[2] The phenomenon of poverty among children in Israel is particularly serious among the Arab Israeli and Haredi (ultra-Orthodox) populations, which are also characterized by very high birth rates (Ben-David & Bleikh, 2013). The data of the NII show that families with children constitute more than one-half of the total number of families living in poverty. Two-thirds of these families live in long-term poverty,[3] with a particularly high incidence among families with high correlates of poverty, i.e. large Haredi families, those without a wage earner of working age, and families where the head of the household has only eight years of schooling or less (NII, 2018).

1 According to the accepted OECD system of measurement, the incidence of poverty is defined as the proportion of individuals whose income is below the poverty line, which is defined as 50 percent of the median disposable household income in the population.

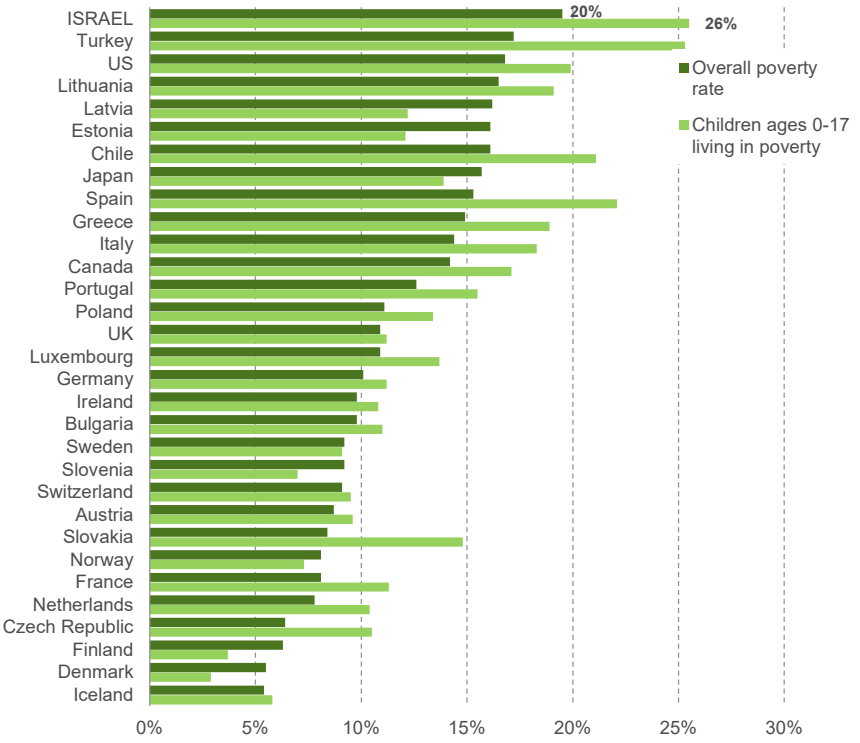
2 The worsening of the incidence of poverty according to Israeli measures as compared to the OECD's methods of measurement is due to the fact that Israel's equivalence scale attributes a greater weight to large families and the share of large families in Israel is much higher than in the other OECD countries (NII, 2018).

3 According to the NII, families living in long-term poverty are those whose income and consumption are both below the poverty line, since consumption is influenced primarily by permanent income rather than temporary fluctuations in income.

Comparative studies have shown that societies with high economic inequality suffer from more serious health and social problems, such as mental illness, obesity, violence, drug abuse, murder, low levels of trust, and low academic achievement (Kaplan, Pamuk, Lynch, Cohen & Balfour, 1996; Wilkinson & Pickett, 2007; 2009). Furthermore, it is well known that countries with a high level of income inequality are characterized by low rates of intergenerational economic mobility, which implies a high level of inequality in economic opportunity (Corak, 2013).

Figure 1. Overall poverty rate and poverty among children ages 0-17, 2015

After taxes and transfer allowances, OECD countries



Source: Dana Vaknin, Yossi Shavit, and Isaac Sasson, Taub Center | Data: OECD, 2016c

2. Inequality in academic achievement in Israel

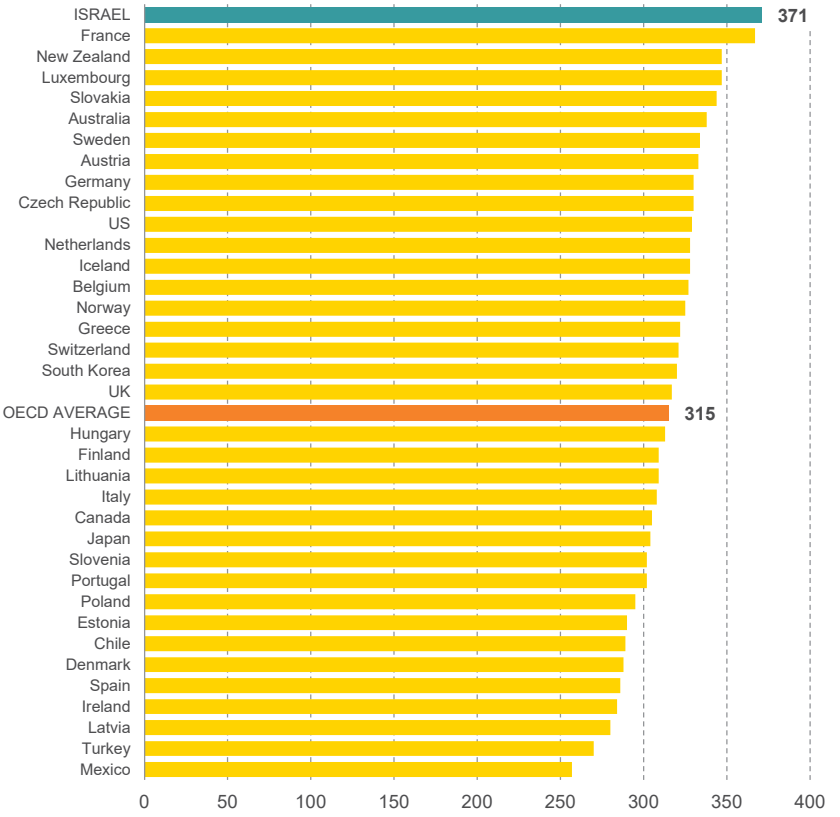
Academic achievement[4] in Israel is much lower than in other developed countries, a situation that has remain unchanged over time and which receives periodic confirmation by various international academic achievement tests, such as PISA and TIMSS (Feniger and Shavit, 2011; RAMA, 2016). Thus, for example, Israel is ranked highest among the OECD countries in the share of students at the lowest achievement level in mathematics (32 percent versus the OECD average of 23 percent). Despite continuous improvements in the Israeli education system over the years (Blass, 2018), the achievements of Israeli students remain disappointingly lower than the OECD average (Dahan, 2018).

Not only do Israeli students perform poorly on international tests, but the level of inequality in achievement among students in Israel is the highest among the OECD countries and has been among the highest of developed countries for decades (Ben Dor, 2011; RAMA, 2016; 2017). For example, in Israel the gap between the representative scores of the 5th and the 95th percentile in scientific literacy on the PISA exam, which measures the academic level of 15-year-olds, is the largest among the 70 countries that participated in the test in 2015 (except for Malta) and is also the largest among the OECD countries. In reading and mathematical literacy, Israel ranks highest among the OECD countries in terms of the gap between the weakest students and the strongest students and is ranked third among all countries and economies that participated in the testing. The reading comprehension scores of students in Israel are the most widely dispersed from among the skills tested, with a gap of 371 points between the representative scores of the 5th and 95th percentiles (Figure 2). The high variance in the scores in Israel is consistently observed in every round of PISA testing and in other international tests as well (RAMA, 2016; Dahan, 2018).

4 The concept of "academic achievement" relates to the quantity of knowledge accumulated by an individual in a defined field, whether or not it has been acquired in the education system. The level of academic achievement and the degree of inequality in academic achievement can be measured using standardized tests such as Meitzav, PISA, the matriculation exams, the psychometric exam, etc. This study will focus on achievement of this type.

Figure 2. The gap between the representative score of the 5th percentile and that of the 95th percentile in reading comprehension on the PISA exam, 2015

OECD countries



Source: Dana Vaknin, Yossi Shavit, and Isaac Sasson, Taub Center | Data: RAMA, 2016

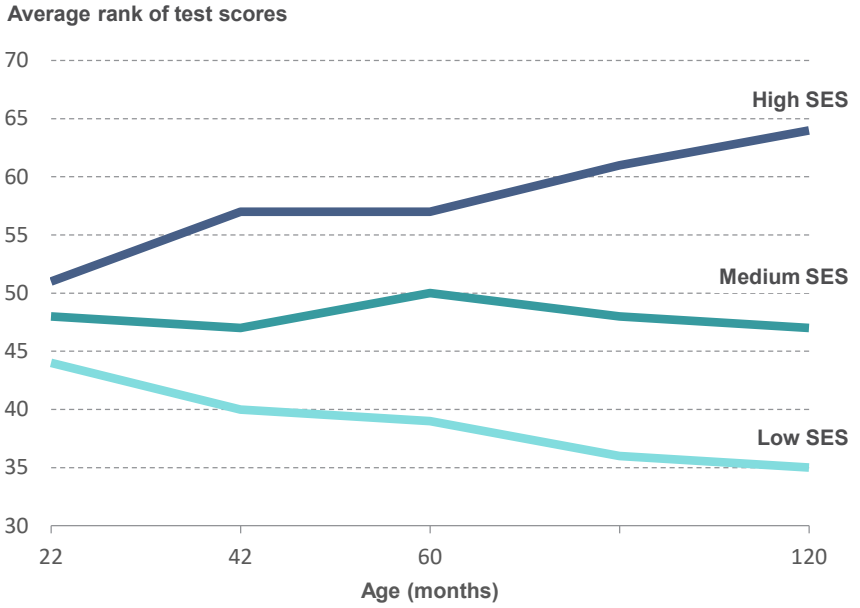
The high inequality in academic achievements among students in Israel is to a large extent a reflection of the economic inequality among families. Research has shown that students from strong socioeconomic backgrounds attain higher academic achievements on average than students from weak socioeconomic backgrounds. For example, the probability of a student

attaining a matriculation certificate — which to a large extent determines his chances of being accepted to academic studies — improves with his family's economic status (Ayalon & Shavit, 2004). Higher income parents can send their children to better schools, can afford tutoring when necessary, and can also afford educational tools such as books and computers for their children (Shavit, forthcoming).

In recent years, it has become increasingly clear that inequalities in academic achievement develop at very young ages, even before children enter the education system (Shavit, Friedman, Gal & Vaknin, 2018). Feinstein (2003), for example, analyzed the results of cognitive tests given to 22-month-old infants in Britain. The findings show that even at that young age there are clear developmental differences according to socioeconomic status.[5] The most striking finding shows that from the moment that developmental gaps appear, they become more pronounced over time (when examined at ages 3½, 5, and 10). The research findings, which are presented in Figure 3, show that, over time, children from strong socioeconomic backgrounds continue to improve their achievements on child development tests, while the relative achievements of children from weak socioeconomic backgrounds decline with age. In view of these and other similar results, researchers have concluded that a relatively large part of the gaps between children from different socioeconomic backgrounds emerge in early childhood (Barnett, 1995, 2011; Feinstein, 2003; Heckman, 2006).

5 Socioeconomic background (or socioeconomic status — SES) is measured according to the occupational classification of the two parents at the time of their child's birth. Similar findings were obtained when socioeconomic background was measured according to the combined education of the parents and also according to the education of the mother or father alone.

Figure 3. Average ranking of cognitive skills among children ages 22, 42, 60, and 120 months by socioeconomic background
United Kingdom, children born in 1970



Source: Dana Vaknin, Yossi Shavit, and Isaac Sasson, Taub Center | Data: Feinstein, 2003

3. The importance of early childhood: A critical developmental period

Advances in the study of the brain, including the development of non-invasive technologies such as MRI and fMRI, have led researchers to the conclusion that the early years of life are an unparalleled window of opportunity for cognitive, emotional, and social development (Rosenzweig, 2003; Sowell et al., 2003; Kuhl, 2004). During this period, the brain develops at a particularly rapid pace. By the age of one, the brain reaches 70 percent of its size; by the age of three, 85 percent; and by the age of five, 95 percent, on average. Researchers who advocate this approach have constructed the theory of "The First Thousand Days," according to which the thousand days from conception until the child's second birthday constitute a critical period

in the development of the child's abilities and also form the basis for future development.[6]

The psychology literature usually distinguishes between a critical period for development and a sensitive period for development. A **critical period** is a specific and defined developmental period during which exposure to necessary stimulation is essential to a particular skill development; lack of exposure results in the skill not developing at that time and sometimes never developing. During this period, the infant is particularly sensitive to the presence or absence of specific experiences or stimuli and only during this period can they have an influence on the development of the nervous system (Bailey, Bruer, Symons & Lichtman, 2001). For example, if one eye is prevented from seeing at a young age, then this will alter the distribution of cells in the brain that deal with vision and may lead to the long-term loss of depth perception (Wiesel & Hubel, 1963). A **sensitive period** is one in which the brain reacts optimally to certain experiences. After the conclusion of this period, the development of the relevant skill is no longer optimal, although it is still possible. For example, it is known that the cognitive system in the brain is particularly sensitive to the acquisition of language in early childhood and in order to acquire language children must be exposed to it at very early stages in their lives (Kuel, Wiliams, Lacerda, Stevens & Lindblom, 1992; Nelson & Sheridan, 2011). An extreme example is Genie, an American girl who from a very young age was subject to severe language deprivation with no social interaction with the rest of her family. Since she was never exposed to language during the critical period, her ability to absorb and produce syntax was limited at a later age (Curtiss, 1977; for a review of the literature, see Shavit et al., 2018, p. 16-30).[7]

In order to understand why early childhood is such a critical period for development, it is important to understand the biological and physical processes that take place during it. Particularly important developmental processes occur even before birth, thus emphasizing the importance of early childhood in neural, cognitive, emotional, and social development. One of these is synaptic printing. At birth, infants have more cells and more synapses than are necessary (known as synaptogenesis); with age, a process

6 For example, http://first1000daysfl.org/ ;https://thousanddays.org/.

7 In recent years, it has become increasingly clear that the boundaries between the critical period and the sensitive period are not sufficiently clear. Thus, development continues even after the critical period, although closing the gaps is much slower, more difficult and incomplete. Therefore, brain researchers currently tend to relate to the sensitive periods as critical periods.

of specialization occurs. During this process, the sensitivity to stimuli that the infant is not exposed to declines, but at the same time, the infant acquires capabilities in those skills that he does practice (Sanes & Jessel, 2013). In other words, on the one hand, there is a decline in the ability to perceive experiences and stimuli that do not occur frequently, while on the other hand, there is an improvement in the acquisition of experiences and stimuli to which there is frequent exposure.

The ability of the brain to change in response to its environment and experiences is optimal in the early years of life, namely in early childhood. Therefore, there are those who claim that educational intervention will be more effective and also more economically efficient during the first three years of life (Heckman, 2006; 2008). Although skills and abilities can be developed at later ages, this occurs optimally at younger ages and requires less energy and investment on the part of both the individual and society (Levitt, 2009).

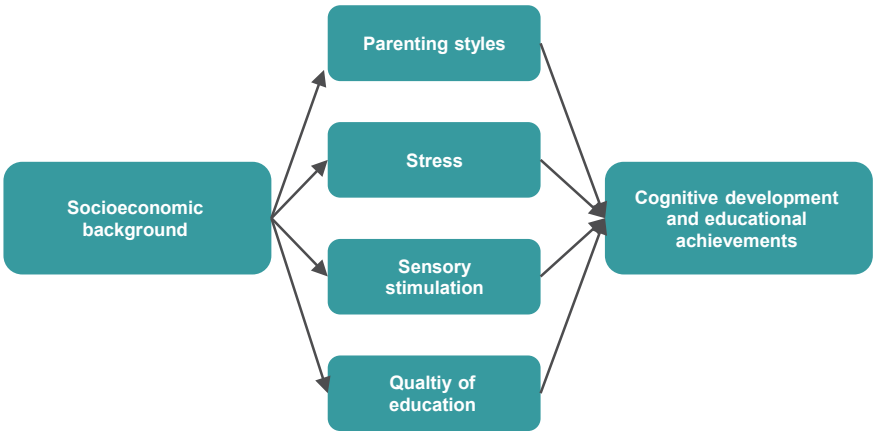
4. The link between family income in early childhood and academic achievement

As mentioned previously, socioeconomic disparities are to a great extent related to gaps in cognitive development from the time of early childhood. Research has shown, for example, that poverty in early childhood has adverse and statistically significant effects on achievement during the third decade of life, including low income, fewer weekly work hours, and fewer years of schooling (Duncan, Ziol-Guest & Kalil, 2010). Studies have even found a relationship between family income in early childhood and the structure of the brain. For example, it was found that family income is related to the total internal surface of the brain in areas responsible for language, reading, spatial perception, and executive function,[8] and that this effect is especially strong among children in families with the lowest incomes (Noble et al., 2015). However, the factors that link between family income in early childhood and the development of learning abilities and academic achievement at later ages constitute a kind of "black box" in this field of research in general and for the current study in particular. The theoretical discussion in this section focuses on the social, family, and biological factors that can explain why developmental disparities are liable to develop between children of different

8 Executive functions are high cognitive control and monitoring processes, such as emotional regulation, delayed gratification, and selective attention.

socioeconomic backgrounds at such an early age, including parenting styles, stress, sensory stimuli, and quality of early childhood education (Figure 4).

Figure 4. The processes that link between family socioeconomic background and cognitive development and academic achievement



Source: Dana Vaknin, Yossi Shavit, and Isaac Sasson, Taub Center

Parenting styles

Families of different socioeconomic status have different parenting styles. For example, Lareau (2011) showed that middle class families concentrate on nurturing the knowledge, skills, and abilities of their children (what she calls "concerted cultivation"), while working class families only provide for the basic needs of their children, such as food, shelter, and physical conveniences, and allow their children to develop naturally without any major investment on their part (what is referred to as "natural growth"). Children in middle class families participate in activities that are organized for them by their parents while working class children spend their leisure hours watching television or playing outside.

Stress

Stress is an individual's feeling of doubt in his ability to deal with a particular situation at a particular period in time. Stress can diminish the functioning of essential nervous systems that are located in the prefrontal cortex, which are responsible for moderating social behavior, planning, and emotions (Hyman & Cohen, 2013). In situations of prolonged stress, there is elevated secretion of hormones such as cortisol, which depress the immune system and lead to cognitive and behavioral changes. The chronic secretion of such hormones can lead to the creation of other psychological symptoms, such as nervousness, mental unrest, anxiety and depression, avoidance and fatigue (Gordon & Hen, 2004; Ropper, Samuel and Klein, 2014). Studies have shown that, during early childhood, the brain is particularly sensitive to stress situations (Lupien et al., 2009) and chronic exposure to such situations in early developmental stages can disrupt cognitive and emotional aspects of normal development and can cause a significant delay in the ability to learn (see Shavit et al., 2018, p. 8-17).

Many researchers believe that among families living in financial distress there is higher likelihood of negative experiences involving high levels of stress, such as exposure to negative environmental stimuli, violence in the family and in the community, the breakdown of the family unit, frequent residential moves, difficulties in the work place, job instability and unemployment, and also greater use of negative parenting strategies (Conger, Ge, Elder, Lorenz & Simons, 1994; McLoyd, 1998; Bradley & Corwyn, 2002; Mullainathan & Shafir, 2013; Lipina, 2016). Prolonged exposure of young children to chronic stress and socioeconomic deprivation (toxic stress) can disrupt the development of brain structure and increase the risk of low cognitive functioning that will continue into adolescence (Lupien et al., 2009; Blair, 2010; Shonkoff, 2011; Shonkoff et al., 2012; Center on the Developing Child at Harvard University, 2019). Young children that experience the burden of their family's economic and social stress are likely to enter the education system with greater risk of behavioral problems, poorer executive functioning, learning disabilities or ADD; they also show lower overall academic achievement in school (Phillips & Shonkoff, 2000; Nelson & Sheridan, 2011).

Sensory stimuli

As noted, during early childhood the brain is particularly sensitive to external environmental stimuli and environmental experiences that then

affect its structural and functional organization. Thus, experiences and environmental influences at an early age can leave a lasting mark on the developing brain's architecture (Shonkoff et al., 2012). The rate of infant brain development is at its peak during the first years of life and the growth in each of its areas is to a great extent dependent on the receipt of the relevant stimuli. These stimuli provide the basis for learning and infants need enriching sensory stimuli for healthy development (Sanes & Jessel, 2013; Child Welfare Information Gateway, 2015). For example, it was found that the average level of intelligence of infants ages 6-31 months who grew up in orphanages in Romania was lower than that of infants who grew up in foster families, due to the lack of sufficient attention and emotional support from caregivers and the low exposure to enriching language stimuli for infants in orphanages (Nelson, Fox & Zeanah, 2013; see also Chugani et al., 2001). In other words, the early years of life are a critical period for the receipt of enriching stimuli — both physical and emotional — that are needed for healthy development.

The family's socioeconomic background in early childhood can influence the supply of sensory stimuli that children are exposed to at this critical age and this is likely to have an influence on cognitive neural development. For example, it has been found that more educated parents invest more time in educational activity connected to early cognitive development, such as reading to their children (Leibowitz, 1974; Timmer, Eccles & O'Brien, 1985; Sandberg & Hofferth, 2001). Research has also shown that parents from a strong socioeconomic background tend to talk to their infant children more and in more complex ways than parents from weaker socioeconomic backgrounds, which supports the development of a broader vocabulary among their infants (Hart & Risley, 1995; Hoff, Laursen & Tardif, 2002). In contrast, parents from particularly weak socioeconomic backgrounds are liable to find it difficult to provide their children with cognitive stimuli, such as toys, books, and other learning tools (Sheridan and McLaughlin, 2014). Parents who have to work at more than one job also have less time and fewer resources to provide these kind of activities for their children (Spera, 2005).

It is important to stress that economic distress is not necessarily related to low exposure to cognitive and intellectual stimuli, although it does seem to reduce the likelihood of high, positive exposure. Furthermore, even though children from strong socioeconomic backgrounds may suffer from a lack of enriching cognitive stimuli, children who grow up in deprived economic situations in general experience greater distress and may have fewer resources available to deal with these stressors (Evans, Li and Whipple, 2013).

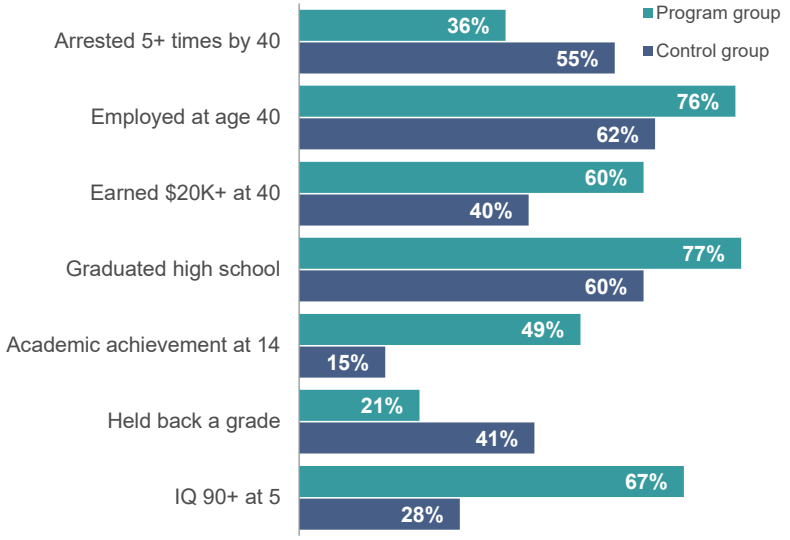
The quality of education in early childhood

Studies have shown that a family's socioeconomic status influences the childcare choices that they make (Fuller, Holloway & Liang, 1996; Early & Burchinal, 2001). For example, there is a greater likelihood that more educated parents send their young children to an educational framework (Kim & Fram, 2009) and that their children spend more time in such frameworks (Early & Burchinal, 2001; Wolfe & Scrivner, 2004). Furthermore, children in families with strong socioeconomic backgrounds tend to participate in higher-quality educational programs (Paszzalunga & Pronzato, 2014; Del Boca, 2015; Kulic, Skopek, Triventi & Blossfeld, 2017). In contrast, children from weak socioeconomic backgrounds are more often in informal childcare arrangements (Early & Burchinal, 2001) and have a lower likelihood of participating in high-quality early childhood education programs (Blossfel et al., 2019).

Research also indicates that investment in education in early childhood can lead to a significant improvement in a child's skills, both cognitive and non-cognitive, which in the long term can improve educational and occupational opportunities. One of the most well-known longitudinal studies in the field of education is the High/Scope Perry Preschool Study, which tracked a group of 3 and 4-year-olds growing up in disadvantaged environments in the 1960s. The children in the study were randomly divided into an experimental group (program group) and a control group. The children in the program group attended a two-year high-quality educational program five times a week for two and a half hours each time, until their entry into kindergarten. The educational staff in the program had academic training, there was a low staff-to-child ratio, and the program included weekly home visits. The children assigned to the control group started kindergarten without having participated in any special early childhood intervention program. The researchers gathered data on the two groups from ages 3 to 11 and again at the ages of 14, 15, 19, 27, and 40. In subsequent studies, it was found that the program yielded a high positive return both for the participants and wider returns for society at large (Barnett, 1985, 1996; Schweinhart et al., 2005; Heckman, Moon, Pinto, Savelyev & Yavitz, 2010). Every dollar invested in the treatment group in early childhood yielded a profit of more than 70 dollars at age 27 (Barnett, 1996). It was also found that, at age 40, those who had been in the treatment group had higher incomes, committed fewer crimes, and had a higher likelihood of completing high school and being employed (Figure 5).

James Heckman calculated the rate of return on the Perry Preschool Intervention Project and found that every dollar invested in the educational intervention at age 4 yields a social return of 60 to 300 dollars by the age of 65 (Heckman et al., 2010). Heckman's most recent study shows that the children of the program participants, who are today 30 years old on average, continue to show benefits in their educational, health, and occupational outcomes. In other words, a high-quality early childhood education for disadvantaged populations can break the intergenerational cycle of poverty (Heckman & Karapakula, 2019).

Figure 5. Results of the High/Scope Perry Preschool Study
For participants at age 40



Source: Dana Vaknin, Yossi Shavit, and Isaac Sasson, Taub Center | Data: Schweinhart et al., 2005

5. The research goal and hypotheses

The goal of this study is to determine whether family income in early childhood has an effect on the future academic achievements of students

in Israel according to standardized tests. Based on the literature review, the study examines two separate hypotheses:

1. There is a positive correlation between family income during early childhood (birth to age 5) and future academic achievement according to the Meitzav exams, even after controlling for family income at later ages and additional sociodemographic characteristics, such as parents' education and family size. In other words, the higher family income is in early childhood, the higher will be the child's academic achievement in adolescence. As indicated by the literature review, many researchers have emphasized not only the relative quantity of socioeconomic resources available to the family but also the unique effect of poverty. According to this approach, poverty experienced in early childhood is liable to adversely affect the supply of cognitive stimuli available to children and to create stress situations, which in turn have a negative effect on outcomes later in life. Therefore, the study will consider not only the effect of income as a continuous variable but also that of being located at the extremes of the income distribution, namely being among the poor and being among the wealthy.

2. The effect of family income during early childhood on academic achievement is stronger for children from birth to age 2 than at ages 3 to 5. This hypothesis is in line with "The First Thousand Days" theory, according to which the sensitivity of infants to environmental influences diminishes with age.

6. Research method

Data

The dataset was produced especially for this study by the Central Bureau of Statistics (CBS). The file was created by merging the Population and Housing Census for 1995 and 2008, the Population Registry and the Meitzav files of the Ministry of Education. The merging of the files was carried out on the level of the individual according to identity number. In order to maintain anonymity, the identity number was replaced by a fictitious number. Data was analyzed in the CBS Research Room and subject to restrictions to ensure privacy.

The fifth Population and Housing Census in Israel was conducted in October-November of 1995. It collected a variety of demographic, economic, and social data on Israel's population and households. A sample of twenty percent of all the households[9] in the census filled out an extended questionnaire that included questions on socioeconomic indicators, such as housing situation, ownership of durable goods, employment, marriage, births, income, standard of living, ethnic origin, religiosity, etc. This was a representative sample of households and population groups in Israel in 1995 (CBS, 1999). In order to obtain the socioeconomic background of the research population in later years, the data from the 1995 census was merged with household data from the 2008 census. In this way, it was possible to identify the participants in the earlier census and to measure their socioeconomic status at two points in time.

Since the study focuses on early childhood, the study subjects were limited to individuals from birth to 5-years-old at the time of the 1995 census, i.e. the 1990 to 1995 birth cohorts. Those same individuals were aged 13 to 18 at the time of the 2008 census. Children who were born during the period 1990 to 1995 and who took the Meitzav exams in Grade 5 were tested between 2000 and 2005.

The full dataset for all the research variables included only a limited number of Arab Israelis and analysis of this population was not possible. The analysis therefore relates only to the Jewish population (for an analysis that also includes the Arab Israeli population, see Vaknin, 2019).

Variables

Table 1 presents the descriptive statistics for the variables used in the analysis. The following is a description of the variables and the measurement methods.

Dependent variable — academic achievement: Academic achievement was measured by means of the Meitzav exam administered in Grade 5 (at age 10). The Meitzav exams are given in school and include tests in math, language skills, English (as a second language), and science. Exams are administered in Israel each year in Grade 5 and in Grade 8 among a representative national sample. The Meitzav exam in mathematics measures the student's proficiency in the basic mathematical principles included in the curriculum,

9 A household is defined as any person living on his own and any group of people living together in the same home and who maintain a joint budget for food expenses. A household usually corresponds with a family (CBS, 2019).

including numerical, algebraic, and geometric skills. In the Meitzav exam, the student is asked to combine mathematical skills, to apply his knowledge of mathematical concepts and to demonstrate his mathematical ability on both a high and low order of thinking. The Meitzav test in the child's native language measures language proficiency, reading comprehension, ability for written expression, and linguistic knowledge. The Meitzav exam in English examines fluency in English relative to the level expected according to the curriculum, including auditory comprehension, reading comprehension, and writing ability. The Meitzav test in science measures scientific and technological proficiency in subjects such as materials, energy, ecological systems, and processes in living organisms (RAMA, 2017; 2018).

The variables taken from the Meitzav exams are the overall score in Grade 5 (the scores in the four subjects range from 0 to 100). In this study, we present the analysis for the Meitzav exams in Grade 5 since they have a greater number of observations with complete information than the Grade 8 tests.[10] For the purpose of the analysis, the scores on the Meitzav exams were standardized within each examination year with the average set to zero and the standard deviation to one.

Family income: This variable measures the average monthly per capita household income, according to the Population and Housing Census of 1995 and 2008, which includes labor income (from the income tax files), NII benefits, and other types of income included in the questionnaire. As is the practice in similar studies (such as OECD, 2011), average monthly per capita income was calculated by dividing monthly household income by the root of the number of household members. The income reported in the 2008 census was adjusted using the CPI for 1995.

Measures of poverty and wealth: In addition to the continuous household income variable, it was determined whether the respondent belonged to one of the extreme quintiles in the per capita distribution of income: the lowest quintile, which we refer to as "poor," and the upper quintile which we refer to as "wealthy." These were measured in the 1995 census (during the period of early childhood) and in the 2008 census (during adolescence) and were defined as dichotomous variables, such that a value of one means that the

10 In most of the subjects on the Grade 8 test, the number of observations for which there was complete information was about 500 or less, which is in contrast to 1000 observations or more for the Grade 5 tests. Therefore, we decided to present the findings for the Grade 5 tests only. Nonetheless, it is important to mention that the findings presented below are also valid for the Grade 8 Meitzav tests for some of the subjects (Vaknin, 2019).

individual belongs to the lower quintile (the poor) or the upper quintile (the wealthy) of the income distribution. We include these two dichotomous variables in the analysis in order to determine whether being poor and/or being wealthy has an impact on achievement in a way that deviates from the linear effect of per capita disposable income. As mentioned, researchers stress the effect of poverty on cognitive development and attribute less importance to the influence of income that is above the poverty line. The variable "wealthy" was also included in the analysis in order to determine whether it is symmetric to that of "poor" and whether it has a particular effect on future achievement.[11]

Parents' education: Parents' education is measured by the highest degree attained upon completion of formal education by the parents. This variable represents the education of the more educated of the two parents. Parents' education was categorized according to a scale of five categories: no education (including those who never attended school or did not obtain any diploma); graduates of elementary school or junior high school; high school graduates without bagrut (matriculation); high school graduates with a bagrut certificate or a certificate from a post-secondary non-academic school; and university graduates (a BA, MA, or PhD). Although formally this variable is measured on an ordinal scale, we relate to it as an interval scale. Tests show that the relationship between this variable and the achievement variables was approximately linear and that the intervals between the average achievements in its categories are similar. Of the parents in the sample, 29 percent have an academic education; 38 percent have a matriculation

11 A regression equation that includes three different measurements of a family's economic situation is liable to suffer from a high level of multicollinearity between the different measures (i.e., high correlation between the variables), which may have an impact on the standard errors and on the estimators' levels of significance. Therefore, we estimated the degree of multicollinearity between the variables by means of a Variance Inflation Factor (VIF). The degree of multicollinearity between the three measures of income (continuous income, being poor, and being wealthy) was examined for all of the tests in all of the age groups. The results are presented in Appendix Table 1. It was found that all of the VIF values are below a threshold of 10 and most of them are even less than 2, which indicates low multicollinearity (Hair, Anderson, Tatham & Black, 1995).

In addition, Appendix Table 2 and 3 present the Pearson correlation between family income in 1995 and in 2008, on the one hand, and the measures of being poor and being wealthy, as well as the other independent variables, on the other hand. This is done in order to test the possibility that the weaker effect of income in a later age group (ages 3 to 5) is the result of a relatively strong correlation of family income in 1995 with the other variables in the model. If that were the situation, it could be claimed that the effects of income on the 3 to 5 age group are "swallowed up" by the other variables in the model. As can be seen, this is not the case. The correlations in this group are in fact weaker than in the younger group (birth to age 2) and they point to links that are weak to intermediate, except in one case.

certificate or a post-secondary, non-academic diploma; 25 percent only graduated from high school; 5 percent finished only elementary school or junior high school; and 4 percent have no formal education.

Student's gender: Gender is measured by a dichotomous variable — with a value of 1 for girls and 0 for boys. Gender was included in the analysis since tests commonly show disparities between the achievements of boys and those of girls (see, for example, RAMA, 2018).

Number of siblings: The number of siblings was measured at two points in time — in early childhood and in adolescence. The number of live births from the Population and Housing Census of 1995 was used to calculate the number of siblings during early childhood. The number of live births in the 2008 census was used to calculate the number of siblings added to the household between the two censuses.

Table 1. Description, averages/percents, and standard deviation of the research variables

Jewish students

Variable	Description	Children born 1993-1995 (birth to age 2)	Children born 1990-1992 (ages 3 to 5)	Total
Family income, 1995	Monthly household income per capita, in NIS, 1995 Census	₪4,562.93 (₪4,263.26)	₪4,797.58 (₪6,715.76)	₪4,685.38 (₪5,677.67)
Family income, 2008	Monthly household income per capita, in NIS, 2008 Census. Adjusted for 1995 CPI	₪7,066.02 (₪5,188.54)	₪7,428.88 (₪5,731.73)	₪7,255.37 (₪5,481.32)
Poor in 1995	Lowest quintile in monthly household income distribution per capita, 1995	20.30 (0.40)	19.70 (0.39)	20.00 (0.39)
Poor in 2008	Lowest quintile in monthly household income distribution per capita, 2008	20.80 (0.41)	19.20 (0.39)	20.00 (0.40)
Wealthy in 1995	Highest quintile in monthly household income distribution per capita, 1995	19.20 (0.39)	20.70 (0.40)	20.00 (0.40)

Table 1. Description, averages/percents, and standard deviation of the research variables

Jewish students

Variable	Description	Children born 1993-1995 (birth to age 2)	Children born 1990-1992 (ages 3 to 5)	Total
Wealthy in 2008	Highest quintile in monthly household income distribution per capita, 2008	18.80 (0.39)	21.10 (0.41)	20.00 (0.41)
Parent's education	Highest degree of most educated parent, 5 category interval scale	3.86 (1.01)	3.82 (1.02)	3.84 (1.02)
Siblings in 1995	Number of siblings. By number of live births of mother for women over 15-years-old, 1995 Census	2.34 (1.28)	2.68 (1.24)	2.52 (1.28)
Additional siblings, 2008	Additional siblings from 1995 to 2008 Census, by number of live births of mother	1.04 (1.12)	0.69 (0.92)	0.85 (1.04)
Gender	Dichotomous variable, 1 = girls; 0 = boys	50.2 (0.50)	51.1 (0.50)	50.7 (0.50)
Born at the beginning of the year	Dichotomous variable, 1 = born January-June; 0 = born July-December	50.4 (0.50)	47.3 (0.49)	45.8 (0.50)
Meitzav score, Math	Adjusted score from each exam year	-0.003 (0.972)	0.005 (1.035)	0.00 (1.00)
Meitzav score, Language skills	Adjusted score from each exam year	0.059 (1.019)	-0.076 (0.969)	0.00 (1.00)
Meitzav score, English (as a 2nd language)	Adjusted score from each exam year	0.059 (0.985)	-0.078 (1.013)	0.00 (1.00)
Meitzav score, Science	Adjusted score from each exam year	0.322 (0.874)	-0.427 (0.995)	0.00 (1.00)

Source: Dana Vaknin, Yossi Shavit, and Isaac Sasson, Taub Center

7. Main findings

In order to estimate the effect of disposable per capita family income in early childhood on academic achievement at a later age, a multivariate linear regression analysis was performed. The models for predicting achievement included family income in the 1995 census (when the child was ages birth to 5), family income in the 2008 census (when the child was age 13 to 18),[12] parents' education, family size, and other sociodemographic variables.[13] In order to test the second research hypothesis, the analysis was carried out separately for two age groups: the 1993 to 1995 cohorts (from birth to age 5 in 1995) and the 1990 to 1992 cohorts (ages 3 to 5). This makes it possible to test whether there are differences between the two age groups and to test the validity of "The First Thousand Days" theory regarding the importance of early childhood.

Appendix Table 4 presents the regression estimators for predicting the score on the Meitzav exams in mathematics in Grade 5. Model 1 relates to children from birth to age 2 during the 1995 census while Model 2 relates to children who were ages 3 to 5 in that census. As already mentioned, the current study examines not only the effect of continuous family income but also the effect of being located at the extremes of the income distribution. Therefore, the income variables of "poor"' and "wealthy" at the two points in time were added (1995 and 2008).

The results for the two regressions presented in Appendix Table 4 show that parents' education has a strong positive effect on achievement, a finding that is familiar from the literature (see, for example, Shavit & Blossfeld, 1993). There also appears to be a negative effect for number of siblings during early childhood. This finding is consistent with previous studies, according

12 For most of the respondents, the dependent variables were measured between 2000 and 2005, i.e., before the measurement of family income in 2008. In this sense, it cannot of course be assumed that there is a causal effect of income at ages 13 to 18 on achievements in Grade 5 (at the age of ten approximately). Nonetheless, we control for the income variables in 2008 in order to reduce the extent to which the effect of income in 1995 mediates the effects of later income. We assume that the disposable family income per capita for families with children aged 10 is highly correlated with their income during the years when their children were ages 13 to 18. A similar calculation which is presented below shows that this correlation is about 0.60.

13 It is important to mention that a preliminary test found that the specific effect of children's economic circumstances in early childhood, as measured in the 1995 census, on academic achievement at later ages remains basically unchanged when the control variable for "new immigrant" is included. This test was carried out in order to control for the possible effect of the large wave of immigration during the 1990s from the former Soviet Union.

to which the number of siblings has a statistically significant and negative effect on educational achievement (see, for example, Shavit & Pierce, 1991; Navon, 2018). In other words, at a given level of parental resources, the greater the number of children, the lower the children's average academic achievements are expected to be. These findings strengthen the theory of dilution of resources, which claims that additional children in a family means that resources are spread more thinly (Downey, 1995). In other words, children who grow up with fewer siblings benefit from a larger portion of the family's resources on average, in contrast to children who grow up in large families, a situation that facilitates more optimal cognitive development (Blake, 1989). These two effects will reappear in most of the analyses presented in this article.

The current discussion focuses on the statistical effect of the family's economic situation in very early childhood (in 1995) on achievement. The first model in Appendix Table 4 indicates that belonging to the lowest quintile in the family income distribution in 1995 has a negative effect on the score in the Meitzav mathematics exam score, even when controlling for income at a later stage, parents' education, size of family, and other variables. It was found that relative poverty experienced in early childhood has a particularly strong and statistically significant negative effect when measured during the first two years of life (b=-0.323, p=0.000), but not for ages 3 to 5 (b=-0.117, p=0.178). In other words, the effect of poverty experienced from birth to age 2 on achievement in mathematics in Grade 5 is greater than the effect of poverty at the age of 3 to 5. The meaning of the coefficient (b=-0.323) is that belonging to the lowest quintile of the income distribution from birth to age 2 results in a lower score on future tests in mathematics of about 30 percent of a standard deviation. Moreover, the differences between the two age groups in the effect of "being poor" were found to be statistically significant (p=0.065).[14] In other words, belonging to the lower extreme of the income distribution from birth to age 2 leads to lower achievements in mathematics in Grade 5. In contrast, later measures of being wealthy and being poor, which were measured in 2008 and at the time of the academic testing, do not show a statistically significant impact on mathematics scores in Grade 5.

14 In order to test the significance of the differences between the two age groups (birth to age 2 versus ages 3 to 5) a dummy variable for the interaction between age group and each of the other independent variables in the model (family income, parents' education, number of siblings, etc.) was added.

Figure 6 and 7 illustrate the relationship between income and achievement using a graphic presentation of predicted scores on the Meitzav test in mathematics in Grade 5 (in standardized scores) for children from birth to age 2 and ages 3 to 5, according to family income in 1995. The middle line represents the average effect of income at three levels: at the level of the poor, at the mid-level, and at the wealthy level. The shading around the middle line represents the degree of variation in these effects (95 percent confidence intervals).[15]

Figure 6 and 7 show that the predicted Meitzav test in mathematics in Grade 5 is not influenced by the change in continuous family income during early childhood. In contrast, the differences in the effect of poverty during early childhood on future achievement between the two age groups is clearly evident. Thus, children from birth to age 2 whose family's income was in the lowest quintile of the income distribution in 1995 achieve lower scores in their adolescence. As mentioned, this effect was not found to be statistically significant for the older age group (ages 3 to 5 in 1995). As can be seen in Figure 6, the confidence interval for those belonging to the lower extreme of the income distribution does not even overlap that of the highest income earners. In other words, poverty in infancy has a statistically significant and large effect on future achievement. The graphs also show that belonging to the top quintile of the income distribution in early childhood ("wealthy") increases the child's future achievements, but as mentioned its effect was not found to be statistically significant.

15 The prediction of the graphs was based on the existing model, which includes both the statistically significant effects and the statistically non-significant effects of the three income measures during early childhood (continuous income, being poor and being wealthy), at the average value of the rest of the variables included in the regressions, including average income in 2008.

Figure 6. Predicted score on the Meitzav exam in math, grade 5, for children from birth to age 2

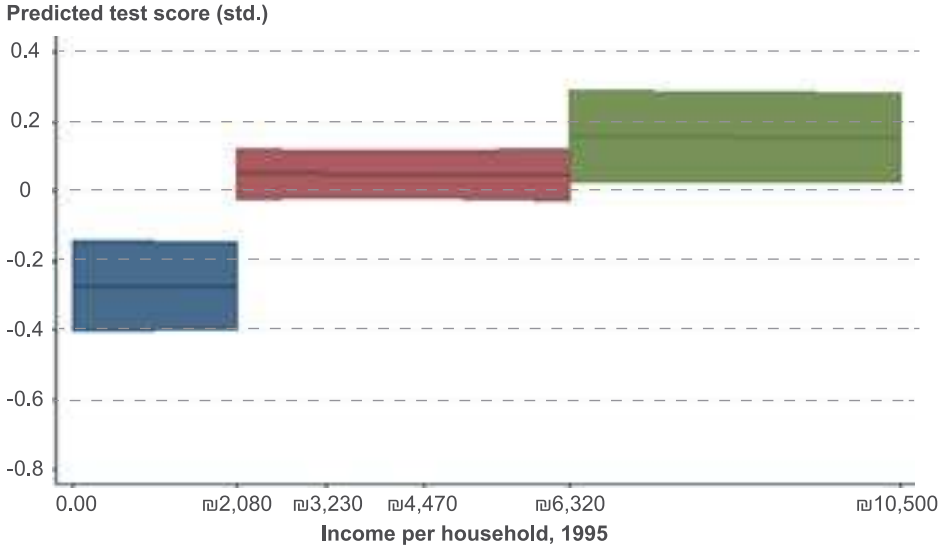
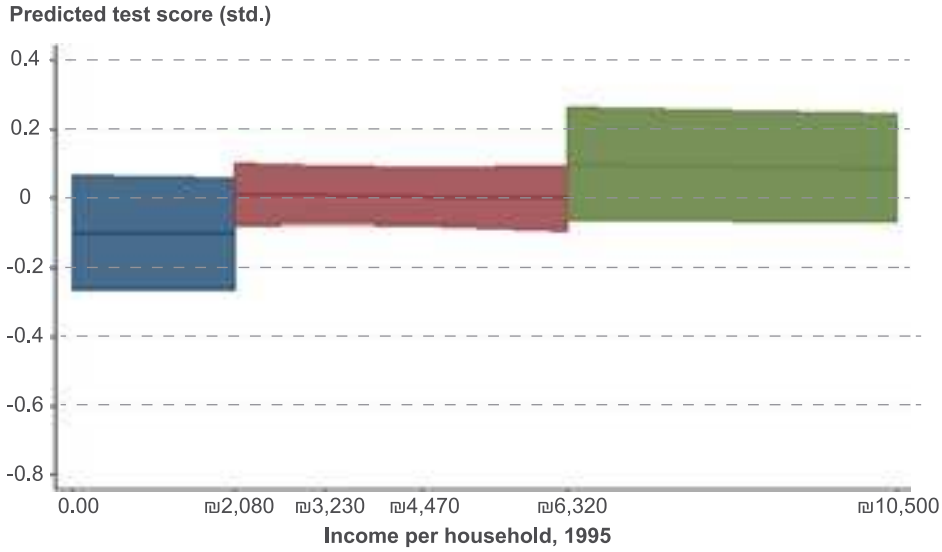


Figure 7. Predicted score on the Meitzav exam in math, grade 5, for children ages 3 to 5



Source: Dana Vaknin, Yossi Shavit, and Isaac Sasson, Taub Center | Data: CBS

At this stage, the question arises as to why the effect of income from birth to age 2 is no longer seen in in the 3 to 5-year-old age group. It is common to think that family income is fairly stable from one year to the next, so the effect of income in the first two years of the child's life should appear as an indirect effect of the measurement of income during the subsequent three years. However, disposable per capita income is not stable among families with infant children. As can be seen in Appendix Table 5, mothers in Israel usually give birth in their late twenties and early thirties (CBS, 2015). At these ages, there is a fair degree of economic mobility. Romanov and Zussman (2003) show that, in Israel, the degree of salary mobility is higher at younger ages than at later ages. This is due to the significant changes that occur in the earning power of younger individuals, which is primarily due to changes in labor force participation rates, seniority at work, acquisition of higher education, and job mobility. Their research shows, for example, that the correlation in salary income between 1993 and 1996 among subjects ages 25 to 34 was 0.68. Moreover, a low share (49 percent) of the poor (who belong to the lowest income quintile) remain in the lowest income quintile for three years. The stability coefficients in salary constitute a kind of ceiling on the stability in disposable per capita family income among families with very young children. This is because in addition to the salary mobility there are additional changes that occur which affect disposable per capita income, such as the increase in the average number of children per family, and there are also changes in family benefits (maternity allowance, maternity leave, etc.).

Appendix Table 6 presents the joint distribution of the disposable income quintiles for households where the head of household is between the ages of 25 and 27 and five years later (when the head of the household is between 30 and 32). Of the households in the lowest income quintile whose head is ages 25 to 27, 30 percent remained in the lowest quintile five years later, 19 percent moved to the second quintile, 13 percent moved to the third quintile, 10 percent moved to the fourth quintile, and 8 percent moved to the highest quintile (Rubashevski-Banit, 2019). In other words, a fairly significant share of the households moved to a different income quintile after five years. The correlation between disposable per capita income quintile of the head of a household ages 25 to 27 and disposable per capita income quintile five years later is only 0.39. As previously mentioned, this is evidence of the high rate of mobility in disposable income among households with young children

and this makes it possible to explain why the effect of family income from birth to age 2 does not persist for ages 3 to 5.[16]

The parallel analyses for the Meitzav scores in Grade 5 for language skills (Hebrew), English (as a second language), and science appear in Appendix Table 7 to 9 and the results are quite similar to those for mathematics. These models also show that belonging to the lower quintile of family income in 1995 has a strong and statistically significant negative effect when measured from birth to age 2, but not when measured later in childhood. These tables also show that — as in the case of mathematics — the measures of later income (measured in 2008) do not have a statistically significant effect on achievement. To illustrate, we present the findings for Hebrew in Figure 8 and 9 (a similar pattern was found for English and science). These graphs also clearly show the substantial differences between the two age groups (birth to age 2 versus ages 3 to 5) in the effect of poverty on academic achievement in Grade 5.

In order to test whether family income in early childhood has an effect on achievement in later life, we estimated the effect of poverty also on the likelihood of eligibility for bagrut (matriculation). Since this is beyond the scope of the discussion, it will be mentioned only that the findings remain unchanged. Thus, poverty from birth to age 2 reduces the likelihood of qualifying for a bagrut certificate, which was not the case for the 3 to 5 age group (see the full findings in Vaknin, 2019). These results may indicate that an environment of poverty experienced in early childhood is liable to create a long-term path dependency with respect to academic achievement. In other words, poverty from birth to age 2 is likely to have an adverse effect on achievement at young ages which in turn is likely to have an adverse effect on later achievement during adolescence (Case, Lubotsky & Paxson, 2002; Cunha, Heckman, Lochner & Masterov, 2006; DiPrete & Eirich, 2006).

16 The skeptical reader can be persuaded by another argument, as follows: Ideally, the data analyzed should include measurements of poverty for the two age groups (birth to age 2 and ages 3 to 5). This would have made it possible to estimate the effect of each of the poverty measurements on future achievement (which we will refer to in their standardized form as a and b). Unfortunately, we do not of course possess repeat measurements and we estimate the influence of each measurement separately (which we will refer to in their standardized form as a* and b*; their values are 0.128 and 0.043 respectively). It can be shown that the following equalities hold: b*=b+ra; a*=a+rb, where r is the correlation between disposable per capita income for the two age groups. Based on the aforementioned, it can be assumed that this correlation is equal to about 0.39. The solution of the equations for the two unknowns — a and b — yields -0.152 and -0.061, respectively. In other words, the finding that the effect of poverty from birth to age 2 is much stronger than for children ages 3 to 5 would be correct even if we had two measurements.

Figure 8. Predicted score on the Meitzav exam in language skills, grade 5, for children from birth to age 2

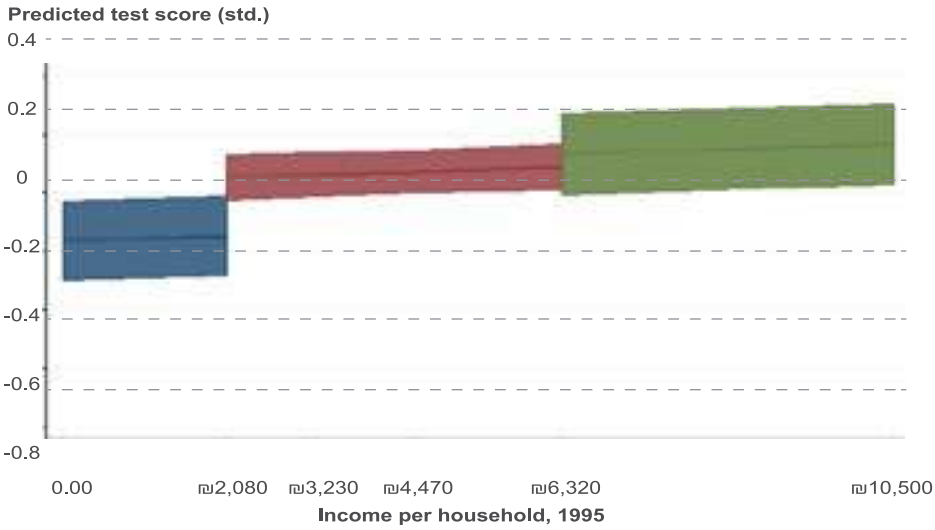


Figure 9. Predicted score on the Meitzav exam in language skills, grade 5, for children ages 3 to 5

Source: Dana Vaknin, Yossi Shavit, and Isaac Sasson, Taub Center | Data: CBS

8. Discussion

This study examines the question of whether the economic situation of families when their children are infants has an effect on later academic achievements of students in Israel. According to the findings, this is the case. Belonging to the lowest quintile of the income distribution during early childhood has a negative and statistically significant effect on future academic achievement, after controlling for family income at later ages and additional background variables, such as parents' education and size of family. Furthermore, the effect of relative poverty in early childhood on future educational achievement was found to be particularly strong when measured for those from birth to age 2 — more so than when measured for the 3 to 5-year-old age group.

Based on these findings, it can be claimed that poverty experienced in early childhood is liable to create a kind of "scar" that remains and may even widen over time since research suggests that small gaps between individuals or groups at an early stage in life tend to increase over time. The findings of this study provide support for the "The First Thousand Days" theory, according to which the sensitivity of the child to his environmental conditions is greater during the first two years of life.

This study supports the theories that emphasize the unique effect of poverty on circumstances later in life. According to this research approach, poverty has negative effects on academic achievement, and these effect may be mediated, for example, by situations of chronic stress that have their origins in a lifestyle shaped by poverty. The study found clear evidence for the unique effect of poverty during the early years of life, as shown in the models for predicting achievement on the Meitzav exams. An alternative approach states that family income improves academic achievement at all levels of income, both high and low. This approach asserts that the more socioeconomic resources are available to the family, the more resources are available to strengthen children's cognitive development and learning abilities. It is important to say that this approach does not distinguish between the various stages in early childhood in the measurement of economic status, while this study highlights the differences. Whatever the case, our findings do not support the claim that higher income at any point in early childhood has a positive effect on future achievement. Rather, our findings indicate that poverty has a unique effect while family income above the poverty threshold during early childhood does not have a major effect on future achievement.

One of the most important findings emerging from this study is that major differences exist between the various stages of early childhood with respect to the effects of poverty on future academic achievement. As mentioned, the effect of relative poverty during early childhood was found to be stronger when measured from birth to age 2 than when measured at ages 3 to 5. Based on these findings, it can be claimed that early childhood should not be viewed as a single stage with uniform characteristics throughout, but rather consideration should in fact be given to "The First Thousand Days" theory, since that period is the most important in determining the future development of a child.

In Israel, the investigation of early childhood is particularly important for several reasons. First, the population in Israel is younger than in other developed countries. The main reason for this is the particularly high average fertility rate of 3.1 children per woman. This is the highest rate among the OECD countries, where the average fertility rate is 1.6 children per woman (OECD, 2016a). In Israel, there are currently about 2.5 million children under the age of 18, which constitute about one-third of the population and of which about 40 percent are under the age of 6 (CBS, 2016; Israel National Council for the Child, 2016). Furthermore, poverty among children in Israel is more common than in other OECD countries. According to the data, about 26 percent of children under the age of 17 in Israel live in households whose disposable income is below the poverty line while the rate among the OECD countries is only half that (OECD, 2016c). In other words, Israel has a large number of children, many of whom are infants, and a great number of them live in relative poverty.

The effect of the timing and duration of poverty on the life circumstances of children in Israel has not been the subject of an in-depth investigation and therein lies the importance of this study. According to the literature, infants living under conditions of extreme poverty are likely to suffer from chronic stress and insufficient exposure to positive and enriching stimuli, and therefore their cognitive and emotional development is liable to be delayed relative to children with a higher socioeconomic status. These developmental gaps can explain part of the gaps in academic achievement between socioeconomic levels, which are, as discussed previously, among the widest in the developed world. Therefore, this study can make a unique contribution to the investigation of inequality in academic achievement in Israel.

The results of the research are likely to have important implications for social policy. First and foremost, the research demonstrates the importance of reducing the extent and incidence of poverty among children and

particularly poverty in the early years of life. As mentioned, the incidence of poverty among children in Israel is among the highest among the developed countries (NII, 2018). Thus, for example, consideration should be given to shifting some of the Child Allowance from adolescents to in infants, which would help young parents improve the quality of their children's childcare and education at this critical age, particularly among the most disadvantaged families. Currently, the Child Allowance is universal and is paid from birth until the age of 18, without any major change in its amount over this period (Wasserstein, 2016). In the current study, it was found that the early years of life, and in particular birth to age 2, have long-term effects on students' level of achievement. Therefore, it may be worthwhile to consider adopting a different distribution pattern for the Child Allowance in Israel, such as decreasing it for families with older children in favor of families with very young children.

Finally, consideration should also be given to the quality of early childhood education. The Compulsory Education Law in Israel does not apply to children from birth to age 3. Despite the high rate of fertility (OECD, 2016a), the rate of employment among mothers of children up to age 3 in Israel is very high relative to the OECD countries (OECD, 2014; 2016b). The high rate of employment among these mothers is also related to high rates of registration for early childcare facilities (OECD, 2017). In Israel, one-third of children under the age of three is in a preschool framework, which is very close to the average for the OECD countries. However, only 20 percent of the children in this age group are in recognized childcare frameworks under government supervision (Israel National Council for the Child, 2016; OECD, 2017). In other words, there are a large number of young children with working mothers who send their children to childcare that is unregulated and are not subject to any form of government or public monitoring. In view of the importance of early childcare frameworks in the development of a child's abilities, both cognitive and non-cognitive, and in particular those children living in conditions of economic distress, greater importance should be given to increasing the accessibility of high-quality educational frameworks for young children, particularly during the first years of life.

An important constraint on this study is the lack of repeat measurements of income during early childhood. There is no long-term survey in Israel that tracks families and children over a sufficiently long period and on a scale that would enable a reliable statistical analysis. In order to answer the research question, two measurements of family income, which were taken from the Population and Housing Census in 1995 and 2008 had to suffice. Today, there is a growing understanding that exposure to poverty in early childhood

has a cumulative effect over time. Thus, the environment experienced at a young age is likely to create long-term path dependency into adult life, in the areas of education, employment, and even health (Case et al., 2002; Cunha et al., 2006; DiPrete & Eirich, 2006). Research has also found that poverty beginning in early childhood and continuing over time has a decisive effect on cognitive abilities later in life, relative to poverty experienced at later ages (Guo, 1998). In order to estimate the cumulative effect of poverty in early childhood on students' academic achievement, repeat measurements of family income over time are needed, as well as repeat measurements of academic achievement throughout childhood.

Unfortunately, the data did not allow the inclusion of the Arab Israeli population in the analyses. Furthermore, there are no data that make it possible to examine the effects of poverty on children's development in many of the Haredi communities. These constraints make it difficult to draw conclusions from the research that apply to the entire population in Israel.

In future research, it is our intention to deal with some of the limitations encountered in this study. First and foremost, we will not continue to use the Population Census as a measure of family income, since it provides a low number of observations with complete data. The share of a cohort for which there is data on family income in the two census periods is only 3 to 4 percent. In future research, we intend to measure parents' income using income tax data in combination with the records of the Population Registry. The use of income tax data allows a larger sample and the inclusion of the Arab Israeli population in the analysis, and also enables the measurement of income continuously for the years from the birth of the subject until the year of the Meitzav exams. A larger sample size allows the addition of a fixed effects analysis to examine the differences between the effects of income for siblings in the same family who were born in different years between 1990 and 1995.

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Appendix

Appendix Table 1. Multi-collinearity variance inflation factor (VIF) test, for all variables in the model

	Meitzav Grade 5			
	Math	Hebrew	English	Science
Born 1993-1995 (birth to age 2)				
Income in 1995	1.539	1.545	1.544	1.536
Poor in 1995	1.271	1.271	1.271	1.263
Wealthy in 1995	1.681	1.678	1.701	1.681
Income in 2008	3.384	3.416	3.389	3.369
Poor in 2008	1.414	1.421	1.414	1.406
Wealthy in 2008	2.720	2.742	2.778	2.737
Parents' education	1.364	1.377	1.384	1.368
Number of siblings in 1995	1.311	1.320	1.309	1.290
Additional siblings by 2008	1.255	1.254	1.267	1.244
Gender	1.006	1.007	1.009	1.010
Born at the beginning of the year	1.007	1.006	1.007	1.007
Born 1990-1992 (ages 3 to 5)				
Income in 1995	2.018	1.175	2.062	1.994
Poor in 1995	1.318	1.237	1.319	1.312
Wealthy in 1995	1.964	1.514	1.982	1.932
Income in 2008	3.104	3.129	3.120	3.093
Poor in 2008	1.417	1.414	1.399	1.399
Wealthy in 2008	2.475	2.514	2.458	2.479
Parent's education	1.385	1.383	1.354	1.391
Number of siblings in 1995	1.197	1.217	1.195	1.216
Additional siblings by 2008	1.131	1.150	1.143	1.143
Gender	1.023	1.019	1.017	1.020
Born at the beginning of the year	1.011	1.013	1.011	1.010

Values less than the threshold (VIF<10) indicate low multi-collinearity (Hair et al., 1995)
Source: Dana Vaknin, Yossi Shavit, and Isaac Sasson, Taub Center

Appendix Table 2. Pearson correlation between family income in 1995 and the remaining independent variables for children born 1993-1995, 1990-1992, and the total sample

Pearson coefficient, significance level, and number of observations

	Family income in 1995		
	Born 1993-1995 (birth to age 2)	Born 1990-1992 (ages 3-5)	Total sample
Family income in 2008	0.372**	0.254**	0.291**
	0.000	0.000	0.000
	3,249	3,546	6,795
Poor in 1995	-0.379**	-0.255**	-0.293**
	0.000	0.000	0.000
	3,249	3,546	6,795
Wealthy in 1995	0.620**	0.440**	0.495**
	.0000	0.000	0.000
	3,249	3,546	6,795
Poor in 2008	-0.189**	-0.122**	-0.143**
	.0000	0.000	0.000
	3,249	3,546	6,795
Wealthy in 2008	0.314**	0.231**	0.256**
	0.000	0.000	0.000
	3,249	3,546	6,795
Parents' education	0.311**	0.224**	0.245**
	0.000	0.000	0.000
	2,606	2,913	5,519
Number of siblings in 1995	-0.088**	-0.023	-0.040**
	0.000	0.220	0.003
	2,551	2,852	5,403
Additional siblings by 2008	-0.022	-0.060**	-0.046**
	0.266	0.002	0.001
	2,499	2,731	5,230
Gender (1 = female)	-0.041*	0.021	-0.002
	0.018	0.203	0.901
	3,249	3,546	6,795
Born at the beginning of the year	-0.003	0.002	0.000
	0.869	0.887	0.987
	3,249	3,546	6,795

**p<0.01 (2-tailed); *p<0.05 (2-tailed) | Source: Dana Vaknin, Yossi Shavit, Isaac Sasson, Taub Center

Appendix Table 3. Pearson correlation between family income in 2008 and the remaining independent variables for children born 1993-1995, 1990-1992, and the total sample

Pearson coefficient, significance level, number of observations

	Family income in 2008		
	Born 1993-1995 (birth to age 2)	Born 1990-1992 (ages 3 to 5)	Total sample
Family income in 1995	0.372**	0.254**	0.291**
	0.000	0.000	0.000
	3,249	3,546	6,795
Poor in 1995	-0.293**	-0.274**	-0.282**
	0.000	0.000	0.000
	3,249	3,546	6,795
Wealthy in 1995	0.417**	0.417**	0.417**
	0.000	0.000	0.000
	3,249	3,546	6,795
Poor in 2008	-0.481**	-0.450**	-0.464**
	0.000	0.000	0.000
	3,249	3,546	6,795
Wealthy in 2008	0.780**	0.757**	0.767**
	0.000	0.000	0.000
	3,249	3,546	6,795
Parents' education	0.387**	0.375**	0.379**
	0.000	0.000	0.000
	2,606	2,913	5,519
Number of siblings in 1995	0.010	-0.012	0.003
	0.608	0.516	0.851
	2,551	2,852	5,403
Additional siblings by 2008	-0.141**	-0.117**	-0.133**
	0.000	0.000	0.000
	2,499	2,731	5,230
Gender (1 = female)	0.004	0.025	0.016
	0.841	0.130	0.194
	3,249	3,546	6,795
Born at the beginning of the year	0.006	0.029	0.018
	0.721	0.087	0.149
	3,249	3,546	6,795

**p<0.01 (2-tailed); *p<0.05 (2-tailed) | Source: Dana Vaknin, Yossi Shavit, Isaac Sasson, Taub Center

Appendix Table 4. Linear regression to predict Meitzav exam score in mathematics in Grade 5 for children born 1993-1995 and 1990-1992

	(1) Born 1993-1995 (birth to age 2)		(2) Born 1990-1992 (ages 3 to 5)	
	B	β	B	β
Income in 1995	-0.001	-0.003	-0.003	-0.012
	(0.006)		(0.010)	
Poor in 1995***	-0.323**	-0.128	-0.117	-0.043
	(0.068)		(0.087)	
Wealthy in 1995	0.109	0.045	0.100	0.040
	(0.075)		(0.099)	
Income in 2008	0.017*	0.095	0.004	0.021
	(0.008)		(0.009)	
Poor in 2008	-0.014	-0.006	-0.103	-0.039
	(0.070)		(0.087)	
Wealthy in 2008***	-0.049	-0.020	0.185~	0.073
	(0.095)		(0.111)	
Parents' education	0.168**	0.172	0.183**	0.189
	(0.027)		(0.032)	
Number of siblings in 1995	-0.082**	-0.109	-0.066**	-0.080
	(0.021)		(0.025)	
Additional siblings by 2008	-0.032	-0.036	-0.027	-0.023
	(0.024)		(0.034)	
Gender (1 = female)***	-0.115**	-0.059	0.054	0.026
	(0.047)		(0.058)	
Born at the beginning of the year	0.109**	0.056	0.138*	0.067
	(0.047)		(0.058)	
Constant	-0.499**		-0.589**	
R^2	0.130		0.101	
N	1,528		1,159	

p<0.01; *p<0.05; ~p<0.10 | * Differences between the two coefficients are significant at the 0.10 level | Standard error in parentheses
Source: Dana Vaknin, Yossi Shavit, and Isaac Sasson, Taub Center

Appendix Table 5. Fertility rates by age, Israeli population

Age	1960-1964	1965-1969	1970-1974	1975-1979	1980-1984	1985-1989	1990-1994	1995-1999	2000-2004	2005-2009	2010-2014
Overall fertility rate	111.4	109.2	115.3	112.5	102.6	95.8	86.7	85.4	87.0	87.9	90.9
19-15	46.6	37.3	40.3	40.5	31.3	22.0	19.4	17.7	16.1	14.0	11.5
24-20	229.5	208.6	203.5	194.8	174.7	153.6	131.7	120.2	114.0	106.3	107.7
29-25	230.3	239.0	226.9	204.9	194.3	201.7	193.0	189.7	179.5	171.5	174.8
34-30	154.0	168.1	170.4	150.3	137.5	144.8	147.3	156.7	161.5	167.1	177.2
39-35	77.5	84.9	91.8	80.8	71.8	73.7	75.8	81.7	88.5	96.0	105.3
44-40	26.3	23.3	24.3	19.6	15.8	17.0	17.6	19.4	21.8	24.4	28.2
49-45	5.9	5.6	3.7	2.4	1.4	1.4	1.7	1.5	1.8	2.5	3.1
Total fertility	3.85	3.83	3.80	3.47	3.13	3.07	2.93	2.93	2.92	2.91	3.04

Source: CBS, 2015

Appendix Table 6. Disposable household income mobility per capita after 5 years

25-27-year-olds

Income quintile after 5 years	1	2	3	4	5
1	0.30	0.23	0.14	0.07	0.03
2	0.19	0.24	0.25	0.15	0.06
3	0.13	0.16	0.21	0.25	0.14
4	0.10	0.12	0.15	0.24	0.28
5	0.08	0.11	0.12	0.18	0.40
Share of households removed from the sample	0.21	0.14	0.12	0.10	0.09

Source: Rubashevski-Banit, 2018

Appendix Table 7. Linear regression to predict Meitzav exam score in language skills (Hebrew) in Grade 5 for children born 1993-1995 and 1990-1992

	(1) Born 1993-1995 (birth to age 2)		(2) Born 1990-1992 (ages 3 to 5)	
	B	β	B	β
Income in 1995	0.008	0.037	-0.003	-0.023
	(0.006)		(0.003)	
Poor in 1995	-0.200**	-0.076	-0.076	-0.030
	(0.072)		(0.078)	
Wealthy in 1995	0.045	0.018	0.105	0.044
	(0.080)		(0.081)	
Income in 2008	-0.001	-0.004	-0.001	-0.008
	(0.009)		(0.008)	
Poor in 2008	-0.056	-0.022	-0.076	-0.031
	(0.075)		(0.082)	
Wealthy in 2008	0.137	0.054	0.170	0.072
	(0.102)		(0.105)	
Parents' education	0.209**	0.204	0.176**	0.193
	(0.029)		(0.030)	
Number of siblings in 1995	-0.074**	-0.094	-0.056*	-0.072
	(0.022)		(0.024)	
Additional siblings by 2008	-0.003	-0.004	-0.023	0.154
	(0.026)		(0.032)	
Gender (1 = female)	0.252**	0.124	0.297**	0.068
	(0.050)		(0.054)	
Born at the beginning of the year	0.044	0.021	0.131*	0.067
	(0.050)		(0.054)	
Constant	-0.737**		-0.775**	
R^2	0.117		0.109	
N	1,511		1,153	

**p≤0.01; *p≤0.05 | Standard error in parentheses
Source: Dana Vaknin, Yossi Shavit, and Isaac Sasson, Taub Center

Appendix Table 8. Linear regression to predict Meitzav exam score in English (as a second language) in Grade 5 for children born 1993-1995 and 1990-1992

	(1) Born 1993-1995 (birth to age 2)		(2) Born 1990-1992 (ages 3 to 5)	
	B	β	B	β
Income in 1995	0.009	0.042	0.003	0.010
	(0.006)		(0.010)	
Poor in 1995***	-0.146*	-0.056	0.072	0.027
	(0.071)		(0.085)	
Wealthy in 1995	0.063	0.026	0.010	0.004
	(0.077)		(0.098)	
Income in 2008	0.003	0.015	0.015~	0.081
	(0.008)		(0.009)	
Poor in 2008	-0.053	-0.021	0.043	0.016
	(0.072)		(0.087)	
Wealthy in 2008	0.102	0.042	0.065	0.026
	(0.099)		(0.107)	
Parents' education	0.202**	0.204	0.229**	0.238
	(0.028)		(0.031)	
Number of siblings in 1995	-0.070**	-0.091	-0.085**	-0.105
	(0.022)		(0.025)	
Additional siblings by 2008	-0.042~	-0.046	-0.066*	-0.059
	(0.025)		(0.033)	
Gender (1 = female)***	0.084~	0.043	0.246**	0.122
	(0.048)		(0.057)	
Born at the beginning of the year	0.073	0.037	0.104~	0.051
	(0.048)		(0.057)	
Constant	-0.659**		-0.983**	
R^2	0.107		0.123	
N	1,516		1,146	

p≤0.01; *p≤0.05; ~p<0.10 | * Differences between the two coefficients are significant at the 0.10 level | Standard error in parentheses
Source: Dana Vaknin, Yossi Shavit, and Isaac Sasson, Taub Center

Appendix Table 9. Linear regression to predict Meitzav exam score in science in Grade 5 for children born 1993-1995 and 1990-1992

	(1) Born 1993-1995 (birth to age 2)		(2) Born 1990-1992 (ages 3 to 5)	
	B	β	B	β
Income in 1995	0.001	0.007	-0.001	-0.003
	(0.006)		(0.010)	
Poor in 1995	-0.205**	-0.089	-0.062	-0.024
	(0.064)		(0.087)	
Wealthy in 1995	0.094	0.044	0.075	0.030
	(0.069)		(0.099)	
Income in 2008	0.002	0.011	0.013	0.072
	(0.007)		(0.009)	
Poor in 2008	-0.025	-0.0121	0.026	0.010
	(0.064)		(0.088)	
Wealthy in 2008	0.073	0.033	0.035	0.014
	(0.089)		(0.112)	
Parents' education***	0.144**	0.163	0.164**	0.174
	(0.025)		(0.032)	
Number of siblings in 1995***	-0.071**	-0.106	-0.033	-0.041
	(0.019)		(0.025)	
Additional siblings by 2008	-0.015	-0.019	0.017	0.015
	(0.022)		(0.034)	
Gender (1 = female)***	-0.064	-0.037	0.119*	0.060
	(0.043)		(0.058)	
Born at the beginning of the year	0.040	0.023	0.005	0.002
	(0.043)		(0.058)	
Constant	-0.049		-1.123**	
R^2	0.091		0.067	
N	1,515		1,128	

p≤0.01; *p≤0.05; ~p<0.10 | * Differences between the two coefficients are significant at the 0.10 level | Standard error in parentheses
Source: Dana Vaknin, Yossi Shavit, and Isaac Sasson, Taub Center