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Research in Computational Health

Widening Socioeconomic Inequalities in Early Childhood Language Milestone Attainment in Israel, 2016–2022

Pinchas Akiva, Guy Amit, Irena Girshovitz, Yael Navon, Yair Sadaka, Yossi Shavit, and Sarit Silverman

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Widening Socioeconomic Inequalities in Early Childhood Language Milestone Attainment in Israel, 2016–2022

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Background and literature review

This paper uses child development outcomes to gauge inequality between population groups in Israel — a country characterized by high levels of economic and educational inequalities compared to other developed countries (Shavit et al., 2018). We employ nationwide data from Tipat Halav clinics, Israel's public system of community-based pediatric preventive care services, where children's development is monitored across four discrete domains: gross motor, fine motor, language, and personal-social skills. The dataset includes information on the socioeconomic and demographic background of 1.2 million infants and toddlers, at the resolution of the family, and the geographic statistical area of residence. Here, we focus specifically on language development, as the domain that is most vulnerable to environmental influences (Hoff, 2003, 2006). We estimate the rates of delayed milestone attainment in the language domain across cohorts of children born in the years 2014–2022 to track temporal trends and estimate differences in these trends by maternal education, as a proxy for family socioeconomic status (SES). We hope to use these findings to formulate policy options aimed at reducing social inequalities in child development.

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This paper begins by highlighting the importance of the early childhood period and briefly describes early childhood developmental milestones. The following section reviews published research on the role of family SES in early childhood development, specifically, its relationship with developing language, and the significance of the home environment in shaping language development. The third section describes Israel's unique socioeconomic and demographic makeup and how this unique setting affects child development. The fourth section presents previous research on early childhood development in Israel. The fifth section presents the research questions and hypotheses. The sixth section describes Israel's Tipat Halav system and the dataset used in this study, followed by data analysis and statistical methods. The final sections summarize our findings and their limitations, discuss their theoretical implications, and propose policy options.

Early childhood development and its surveillance

The period from conception through the first two years of life, also known as "the first thousand days," is the most formative in human development (Bailey, 2001; Blossfeld et al., 2017). It is a window of time in which experience and the environment have a proportionately larger influence on cortical and behavioral development than in any other period of life (Cisneros-Franco et al., 2020). Early childhood is also characterized by a more rapid developmental pace than in later periods. The priming of the brain for sensory input, coupled with the rapid developmental pace in the early years, sets the stage for emerging skills for the years to come.

Due to the importance of early childhood development, health systems typically implement developmental surveillance programs, where the attainment of early childhood milestones is monitored in routine health supervision visits (Zubler et al., 2022).[1] Milestones can be categorized into different groups of skills, including language, gross motor, fine motor, and personal-social skills. While each child develops at his/her own pace, milestones provide useful benchmarks to assess on-track development or to raise concerns over a possible developmental delay. Milestone assessment is also important for facilitating timely interventions in cases of developmental delay, to improve long-term outcomes.

1 Israel's Tipat Halav system is described in detail in the section below.

The role of family SES in early childhood development

Beyond the unique genes with which each child enters this world, early childhood development is also cultivated and shaped by the environment (Bronfenbrenner & Morris, 1998; Phillips & Shonkoff, 2000). Neuroplasticity and the brain's ability to change in response to the environment are highest during the first years of life (Dimond et al., 2020; Gilmore et al., 2018; Huttenlocher, 1979; Lyall et al., 2015). Family SES, measured by family income or parental education, heavily influences the home environment and children's developmental potential (Berger et al., 2009; Black et al., 2017, 2021; Duncan & Magnuson, 2012). Studies performed worldwide have found that family SES is a significant predictor of early childhood development, and children from low SES families are at higher risk of developmental delays (Abufhele et al., 2022; Ahmadi Doulabi et al., 2017; Bishwokarma et al., 2022; Hamadani et al., 2014; Koutra et al., 2012; Lopez Boo, 2016; Potijk et al., 2013; Rubio-Codina et al., 2015; Sharma et al., 2019; Sun et al., 2018; Tella et al., 2018; Vásquez-Echeverría et al., 2022).

Two prominent pathway theories used to explain the effects of family SES on child development are the investment model and the family stress model (Linver et al., 2002). The investment model suggests that lower SES families have fewer available material resources in the home that can create an environment fostering healthy development, quantified by the number of books and developmentally appropriate and stimulating toys and activities (Becker & Tomes, 1986; Haveman & Wolfe, 1994; Mayer, 1997). As opposed to material deficits, the family stress model focuses on emotional deficits, especially how high levels of stress — often present in lower SES homes — detrimentally impact parents' emotional availability and sensitivity to their child's needs (Conger et al., 1994, 1995; Elder & Caspi, 1988). In addition to parental availability, prolonged exposure to stress itself can have long-lasting negative effects on development.

Irrespective of pathway, the developmental area that seems to be most vulnerable to the effects of family SES is language (Hoff, 2003, 2006). Studies have consistently found SES-based disparities in language skills in the second year of life, and observed that these gaps widen in later years, suggesting that SES-stratified groups have differential development trajectories for language (Arriaga et al., 1998; Betancourt et al., 2015; Dailey & Bergelson, 2022; Feinstein, 2003; Fernald et al., 2013; Halle et al., 2009; Hoff, 2003;

Huttenlocher et al., 2010; Noble et al., 2015; Rowe et al., 2012; Rowe & Goldin-Meadow, 2009). Language is considered a critical developmental area because early language abilities are one of the strongest predictors of school readiness, reading skills, and academic achievements, all of which contribute to later life-course outcomes (Burchinal et al., 2016; Grøver, 2017; Lee & Burkam, 2002; Scarborough, 2009). Differences in early language abilities between children from low- and high-SES families have ramifications that are critical for school success (Hoff, 2013). Rowe et al. (2012) tracked how individual differences in family SES and the pace of vocabulary growth among toddlers aged 14–46 months predicted school readiness at 54 months. They found that SES, measured by parent education and family income, was a significant predictor of vocabulary growth during toddlerhood, and this growth predicted vocabulary skills at school entry.

The home language environment can be measured by the number of words children are exposed to, as well as by the quality and complexity of the language used at home, and is extremely influential on children's developing language (Brito, 2017). Several studies have found that children from low-SES homes have a less enriched home language environment in all of these dimensions (Brito, 2017; Fernald et al., 2013; Hart & Risley, 1995; Hoff, 2003, 2006). In their landmark study, Hart and Risley (1995) recorded the number of words addressed to children in one-hour monthly observations over two years and compared their measurements between SES levels. Based on these recordings, they estimated that by the age of four, children from higher SES homes heard approximately 30 million more words than their peers from low-SES homes, which contributed to differences in the children's vocabulary.

Research on the home language environment emphasizes the vulnerability of language skills and how optimal environments can foster rich language development, while environments with less conversation, social engagement, and reading can contribute to poorer language skills. These findings imply that the home language environment mediates the effect of family SES and gaps can be closed with sufficient language stimulation. Lurie et al. (2021) found that cognitive stimulation at home longitudinally mediated the relationship between SES and language skills in 5–6-year-old children. Similarly, evidence from recent OECD data showed that by the age of five, disadvantaged children were already behind their peers in emerging literacy skills. However, the data also indicated that they could demonstrate on-par literacy skills if certain

conditions at home were met or if parental behaviors promoted these skills — for example, back-and-forth conversation, reading by parents, promotion of socio-emotional skills, and a high number of books at home (Phair, 2022). In summary, early childhood is a sensitive period for emerging skills, and differences in the home environment heavily influence development, particularly in the language domain.

Israel's unique demographic and socioeconomic composition

Understanding the relationship between family SES and early childhood development is important worldwide, but is particularly significant in Israel due to the country's demography, diverse society, and high levels of inequality (Shavit et al., 2018). Israel has a high fertility rate compared to Western countries, with a total fertility rate of 2.92 children in 2023 compared to the OECD average of 1.58 (OECD, 2023; UN DESA, 2022). The high fertility rate dramatically impacts the population's age distribution, demonstrated by a high proportion of young children: about 10% of the Israeli population is under the age of four, compared with an average of 5.4% in the OECD (OECD, 2020). This high share of young children has fostered a high demand for early childhood education and for health services geared toward young children and families. The high fertility rates also directly affect family size, with an average of approximately 4.6 in Israel, compared to 3.6 in the OECD, and family size, in turn, tends to depress cognitive development (Gibbs et al., 2016; Yu & Yan, 2023).

As well as its high proportion of children, Israel is also characterized by several dimensions of inequality: It has a high Gini coefficient of income inequality, and although education is universal from age three, Israel consistently ranks high in gaps between the lowest and highest performers in international exams such as PISA (Shavit et al., 2018). In addition, Israel has high poverty rates, especially among children (OECD, 2023). In 2018, 22% of children aged 0–17 years old lived under the official poverty line, with slightly higher rates among households with children aged 0–4 years (Navon & Bowers, 2023). Analyzing data from the same year revealed that relative poverty is unevenly distributed between different groups in Israeli society, such that in Haredi (ultra-Orthodox Jewish) society, 58% of children 0–4 were below the poverty line, as were 55% of Arab children, compared with just 8% of non-Haredi Jewish children. The large number of children in Israeli families, coupled with high poverty rates,

in conjunction with the effects of family SES on early childhood development, make it a crucial and urgent task to examine how these factors manifest in developmental indicators among Israeli children.

Previous research on early childhood development in the Israeli population

As described in the previous section, the Israeli population has several unique characteristics. Thus, while lessons can be gleaned from international research, their applicability for Israel are limited. There have been a limited number of large-scale studies conducted in Israel on early childhood development. Gendler-Shalev and Dromi (2022) mapped the growth curves in lexical development among Hebrew-speaking toddlers aged 12–24 months to create norms for a Hebrew version of the internationally used MacArthur-Bates Communicative Developmental Inventory. They found that the gap in vocabulary size between the 10th and 90th percentiles grew with age: at 12 months the gap was 24 words, while at 24 months it was 279 words. This difference in trajectories highlights the importance of developing language between 12 and 24 months, as children who rank lower in vocabulary at an early age tend to acquire new words at a slower pace than children who rank higher.

One study examined the impact of postpartum depression (PPD) on early childhood development using data from Tipat Halav clinics on children born between 2014 and 2015 (Lubotzky-Gete et al., 2021). Data on early childhood milestones (covering four domains — language, personal-social, fine motor, and gross motor) and on sociodemographic family background characteristics were analyzed, along with the mother's score on a PPD screening questionnaire. Infants of mothers with PPD symptoms were significantly more likely to have mild to moderate delays in attaining milestones in all domains, and the largest developmental gaps were observed in language and personal-social milestones.

Using the same Tipat Halav database, a recent report described trends in developmental milestone attainment in Israeli children from birth through age six between 2016 and 2020, including a total of 1,002,700 children (Girshovitz et al., 2023). The report found a gradual increase in the proportion of children who failed to reach developmental milestones in the normative age range across all developmental domains (language, personal-social, fine motor, and gross motor). However, the rise was most significant in the language

domain. In addition, sociodemographic factors influenced the likelihood of not attaining developmental milestones in the normative age range. Consistent with research on family SES and its influence on developing language, previous studies conducted in Israel also point to the vulnerability of language skills in the first years of life.

The rise in developmental disabilities

The rise in the percentage of Israeli children who failed to attain developmental milestones within the normative age range between the years of 2016 and 2020 coincides with the global phenomenon of an increasing prevalence of developmental disabilities such as autism spectrum disorder (Zablotsky et al., 2019; Zeidan et al., 2022). Failure to attain a milestone on time is not a diagnostic indicator, nor is it synonymous with developmental delay. However, it increases the likelihood of developmental delay, which is an important predictor of developmental disabilities. In Israel, the number of children (ages 0–18) who received disability allowances from the National Insurance Institute due to an autism diagnosis rose from approximately 16,000 in 2017 to 36,450 in 2021 — a growth of 128%, compared to a growth of 13% in the general child population (Alut, 2023). This trend is not unique to Israel. According to the Centers for Disease Control and Prevention in the United States, in 2000, 1 in 150 children had received an autism diagnosis, compared to 1 in 36 in 2020.[2] A recent review found that the global prevalence of autism increased from 1 in 161 in 2012 to 1 in 100 in 2022 (Zeidan et al., 2022). In the United States, the prevalence of developmental disability among children significantly increased between 2009 and 2017 (Zablotsky et al., 2019).

Study aims

As noted, early childhood is a foundational stage in human development. This is true for all developmental areas, but previous research points to language as the most susceptible to environmental influences, which can have long-term effects on life course outcomes. The current study focused on family SES differences in language milestone attainment, assessed in a large population-representative sample of Israeli infants and toddlers using data from the Tipat Halav electronic health records (EHR) system. In addition to family SES, we tracked gaps in language milestone attainment by assessment year (with data ranging from 2016–2022), and by age group (0–1, 1–2, and 2–3 years old).

2 See the CDC website, *Data and Statistics on Autism Spectrum Disorder*.

In line with previous research, we expected to find gaps in language milestone attainment by family SES, such that children from lower SES homes would have higher rates of delayed milestone attainment in language compared to children from higher SES homes. In addition, we expected the difference between SES groups to increase with age, such that the differences observed at the ages of 2–3 years would be greater than the differences in the younger age groups. Consistent with the report on milestone attainment in Israeli children, we expected to find that the rate of delayed language milestone attainment would increase with each consecutive observation year (Girshovitz et al., 2023).

Israel's Tipat Halav system and the THIS dataset

Israel's health system provides universal, accessible health services, including Tipat Halav (Hebrew phrase for "drop of milk") clinics that provide free pediatric preventive care to children from birth up to six years old. These clinics are at the forefront of safeguarding the health of Israel's young population. They focus primarily on preventing infectious diseases through vaccination, on early identification of health concerns via regular growth, physical, and developmental surveillance, and on educating parents in health matters.

Families are instructed to bring their children to a Tipat Halav clinic shortly after postpartum hospital discharge, and then when the child is aged 1, 2, 4, 6, 9, 12, 18, 24, 36, 48, and 60 months. Notably, these scheduled visits incorporate developmental surveillance, ensuring that children's developmental milestones are closely observed. During the first Tipat Halav visit, the nurse interviews the parents about the family background (for example, maternal education and parents' marital status), and parents are asked to bring the infant's hospital release forms. The nurse enters the interview responses and hospital birth data into the EHR system.

Israel boasts around 1,000 Tipat Halav clinics spread throughout the country. All clinics adhere to uniform national care protocols, assuring consistency in healthcare provision. For this study, data from Tipat Halav clinics operated by the Ministry of Health, the Jerusalem and Tel Aviv municipalities, and the Leumit health fund were utilized. These clinics share a common EHR system. This dataset encompasses approximately 70% of Israeli children from birth to age six. As previously highlighted, it offers a perspective on the developmental status of children across the board in Israel (Girshovitz et al., 2023).

Developmental surveillance at Tipat Halav clinics is conducted by assessing age-appropriate milestones across four domains: gross motor skills, fine motor skills, language development, and personal-social development. These milestones have been adapted from well-established developmental scales such as the Sally Provence Developmental Profile, Denver Developmental Scale, and Gesell Developmental Schedule (Ball, 1977; Frankenburg et al., 1992; Frankenburg & Dodds, 1967; Provence et al., 1995). The surveillance protocol has been collaboratively crafted by a Ministry of Health task force, comprising diverse healthcare professionals including pediatricians, nurses, physical therapists, speech pathologists, occupational therapists, and child psychologists. Recently, the population norms for these milestones have been validated using the Tipat Halav dataset to establish a new, evidence-based surveillance scale known as the Tipat Halav Israeli Surveillance (THIS) Scale (Sudry et al., 2022).

During children's routine visits to Tipat Halav clinics, dedicated public health nurses assess children's developmental milestones in accordance with their age. Children's performance is evaluated based on their observable behaviors during the clinic visits. In cases where it is difficult to perform a direct evaluation, the child's developmental achievements are recorded based on parental reports. All these assessments and their outcomes are recorded within the EHR system.

The EHR system was developed specifically for Tipat Halav use. It is used to collect and store clinical and demographic data, with data input carried out by the clinic's staff, including both nurses and physicians. An anonymized version of the stored data was provided for this study by Timna, the Ministry of Health's big data platform.

Data analysis and statistical methods

The data source used in the current study was the EHR database, which included, as described above, 70% of Israeli children. We obtained data from children born after January 1st, 2014, who were assessed at least once between January 1st, 2016 and December 31st, 2022.

There were three main stages in the analysis. First, we derived the empirical rates of delayed milestone attainment in language in each calendar year and

each age group, and observed the trends of these rates stratified by maternal level of education, without controlling for any possible confounders.

Second, a series of mixed-effects linear models were used to identify the relationship between delayed language milestone attainment and maternal education. The models included family-level demographic predictors and child-level birth-related predictors as control variables, and random intercepts for SES variables of the statistical areas of residence. In addition, the model included interaction terms of maternal education and assessment year. The regression models were estimated separately for three subsamples of children who had been assessed during their first, second, or third years of life. This allowed the use of a larger sample of children, including those who were not assessed at all ages, and facilitated examination of how the relationship differs by age. However, we could not directly compare the measures of delayed milestone attainment between age groups, as since each age group had a different number of milestones assessed (see Table 1). Details of all the variables included in the models are provided below.

Third, to assess whether results were influenced by differences in subsamples by age groups, we conducted sensitivity analyses as described below. All analyses were performed using Python version 3.9 (Python Software Foundation) and R version 4.2 (The R Project for Statistical Computing).

The *key independent variable* in the current study was maternal education, as reported by the mother in the first Tipat Halav visit and divided categorically (primary school, high school, tertiary, academic). Maternal education was selected as a proxy of family SES and is available for each child.

In addition, the following predictors were extracted for each child and included in the models:

- Maternal employment status: employed, unemployed, student[3]
- Marital status: married, single, divorced, other
- Population group: Jewish, Muslim Arab, Christian Arab, Druze, Bedouin, Other
- Maternal age at child's birth: ≤20, 21–40, >40
- Assessment year: the calendar year in which the majority of the assessments were measured, from 2016 to 2022

3 As described above, demographic details are collected during the first Tipat Halav visit and are not based on administrative data.

- Child's sex: male, female
- Gestational age at birth: <28 weeks, 28–31 weeks, 32−36 weeks, ≥37 weeks
- Birthweight: <2.5 kg, 2.5–4 kg, >4 kg
- Apgar score: <8 or ≥8, one minute and five minutes after birth
- Type of birth: vaginal, assisted delivery, Cesarean section

In addition, the geographic statistical areas of residence (1,553 different areas) were extracted and the following variables per area were used in the model, based on information provided by Points and the Israel Central Bureau of Statistics (CBS, 2021; Hananel et al., 2022; Points, 2019):

- Local socioeconomic cluster: 1–10
- Proportion of Haredi population in the area: none, low, medium, high, very high

Missing values in categorical variables were handled as a distinct category.[4]

The *key dependent variable* was the developmental outcome of language milestone attainment. Based on the binary outcome of milestone attainment we derived a measure of delayed milestone attainment, during the 1st, 2nd, and 3rd year of life. For each age range, a child was considered as having delayed milestone attainment if s/he failed to attain an age-appropriate language milestone in any visit during that year. The binary outcome of failure or attainment is based on the norms of the THIS developmental scale, which is routinely used by the MHCHs (Sudry et al., 2022). The list of the assessed language milestones is displayed in Table 1.

4 When the analysis was conducted with the missing values removed, the qualitative results remained the same.

Table 1. The THIS developmental scale's language milestones by age group

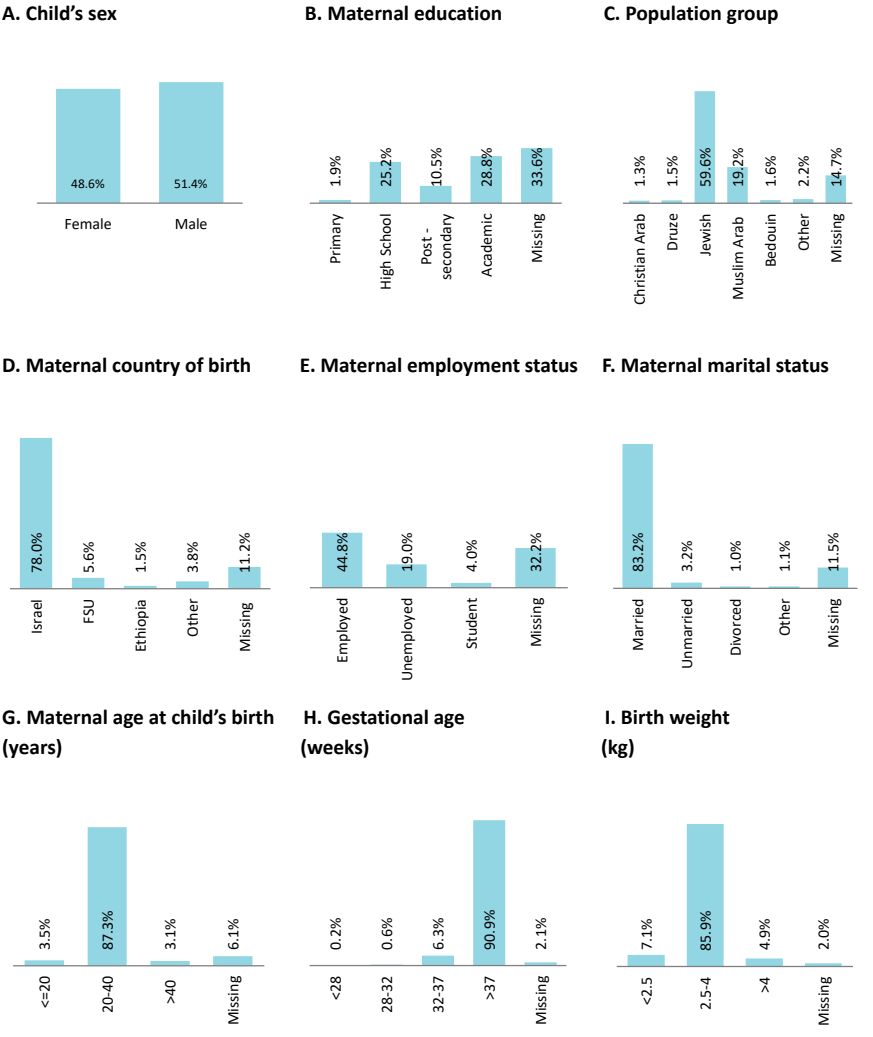
0–1 years	1–2 years	2–3 years
1. Vocalizes in response to human voice	1. Points at familiar objects to request	1. Has a vocabulary of over 10 words
2. Responds to rattling sound	2. Says 2–3 words	2. Composes a sentence of at least 2 words
3. Makes various sounds including consonants (i.e., mm rr gg)	3. Familiar with at least 1 body part	3. Recognizes familiar objects and pronounces them by name
4. Makes repetitive syllables-consonants or vowels		4. Understands actions and speech without gestures
5. Understands simple instructions		5. Expresses freely
6. Says 1 word or pronounces meaningful sounds		
7. Expresses will vocally or with gestures		

Source: Akiva et al., KI Institute and Taub Center | Data: Sudry et al., 2022

Results

As described above, the database consists of developmental assessments of over a million children, who visited Tipat Halav clinics from birth to three years old. Figures 1A–1I present the percentage distributions of the children's main birth data and their mothers' demographic characteristics, which we included in the analyses below (full demographic characteristics by age group are presented in Appendix Table 1). As is standard in child populations, boys comprise a small majority (51.4%) of the children at these ages. Regarding religion, data were missing for about 15% of the mothers. Approximately 60% of the mothers identified as Jewish, and about 20% identified as Muslim. The remaining mothers identified as either Christian, Druze, or Other. Of the mothers for whom information is available regarding their education (about 66%) and employment status (68%), over half reported having tertiary, college, or university education (39.3%), and two-thirds reported that they were employed (44.8%). The vast majority of mothers were Israeli-born (78%), married (83.2%), and between the ages of 20–40 years old at the time of the focal child's birth (87.3%). Over 90% of the children were born full-term (at the gestational age of 37 weeks or more), and for over 93% of the children, birth weight exceeded 2.5 kilograms.

Figure 1. Cohort characteristics: Percentage distributions of key variables

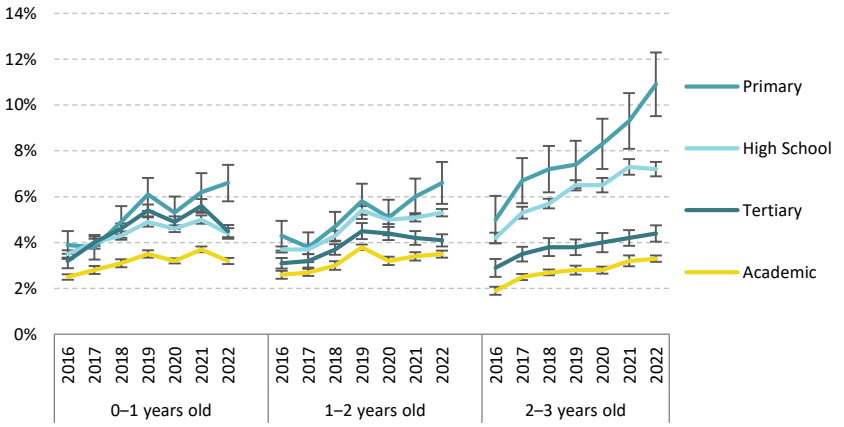


Note: N=1,174,047 children.

Source: Akiva et al., KI Institute and Taub Center | Data: Ministry of Health, Machshava Briah (Healthy Thinking) dataset

The series of graphs in Figure 2 displays the percentage of children with delayed language milestone attainment, stratified by assessment year, age group, and maternal education. The percentages were computed for subsamples of children by age group: 886,345 children at age 0–1 years, 830,820 at age 1–2 years, and 652,423 at age 2–3 years. Across the years and age groups, we found a significant inverse relationship between maternal education and delayed milestone attainment: as maternal education level decreases, the rates of delayed milestone attainment increase. This inverse relationship strengthens with increasing age: the gap in delayed milestone attainment between children with low versus high maternal education was found to be largest among the 2–3-year-old children, compared to the 0–1 and 1–2 age groups. In addition to the effect of maternal education, the graphs reveal a worrying temporal trend: with every successive year, the percentage of children with delayed language milestone attainment increases, and this trend is most evident among children of lower-educated mothers. These trends began before 2020, and the slope is relatively stable throughout the observation years, suggesting that this trend is not related to the COVID-19 period of lockdowns and increased parental stress.

Figure 2. Percentage of children with delayed language milestone attainment by assessment year, age group, and maternal education



Notes: The rates were calculated from empirical data, without model-based adjustments. The vertical bars represent 95% confidence intervals.

Source: Akiva et al., KI Institute and Taub Center | Data: Ministry of Health, Machshava Briah (Healthy Thinking) dataset

Figure 3 displays the marginal effect of maternal education on the probability of delayed language milestone attainment in each age group and across assessment years, controlling for the remaining variables in the model. We used multi-variable linear mixed models to estimate the marginal effects and control for the independent variables displayed in Figure 1, as well as the interaction between maternal education and assessment year (the regression estimates are presented in Appendix Table 2). The results indicate that the pattern of the estimated marginal effects of maternal education is similar, but not identical, to the patterns of the empirical data displayed in Figure 2: the probability of delayed language milestone attainment is negatively related to maternal education, especially in the 2–3-year-old age bracket. In addition, the probability of delayed language milestone attainment tended to increase between 2016 and 2022, although the rise is not uniform across maternal education categories. Interestingly, the coefficients for Druze subjects and for areas with high proportions of Haredi residents are negative, suggesting lower rates of delayed language milestone attainment in these groups.

Robustness checks

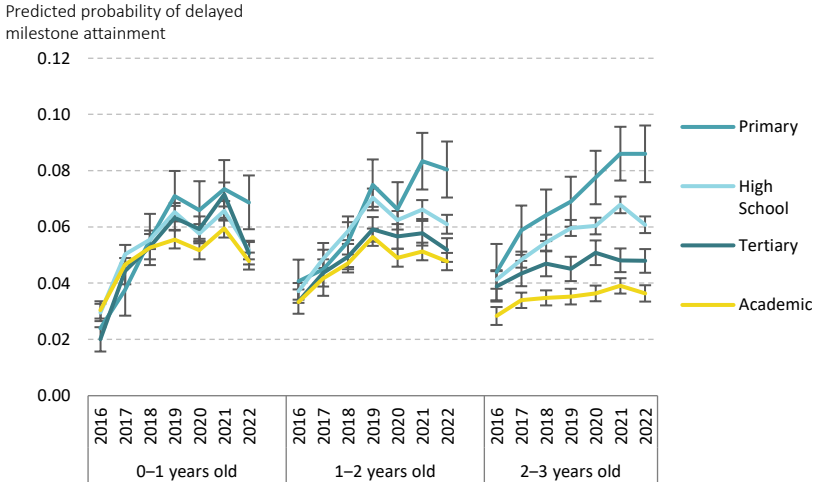
The regressions presented in Appendix Table 2 were estimated separately for three subsamples of children who had been assessed during their first, second, or third years of life. About half of the children in the total sample had complete assessments, i.e., they were included in all three subsamples. The differences between age groups in the marginal effect of maternal education on the probability of delayed language milestone attainment may be spuriously related, in part, to differences among social strata in the propensity to get assessed at different ages. We address this potential source of bias in two different ways.

First, we estimated logit models for the log odds of the child being assessed in each age group 0–1, 1–2, and 2–3, as well as at all three ages. The marginal effects of maternal education in these four models are shown in Figure 4. As seen, children were more likely to be assessed at ages 0–1 and 1–2 than at ages 2–3. The reason is that the visits during the first two years of life are timed according to the vaccination schedule. Since the large majority of families in Israel follow vaccination guidelines – for example, there was a 98.8% measles vaccination rate among infants in 2021 – there is more availability of developmental assessments for infants and toddlers under two (OECD, 2024).

Assessments decline notably at ages 2–3, reflecting lower compliance due to the absence of scheduled vaccinations. Importantly, we did not find systematic differences in the effects of maternal education on the probability of children being assessed in each age group, suggesting that the patterns in Figures 2 and 3 were not confounded.

The second method by which we evaluated potential bias in the sample was to repeat the analysis shown in Figure 3 for a subsample of children who were assessed in all three age groups (Figure 5). If the results in the initial analysis were due to a spurious effect, the result patterns would be different from those obtained from the separate subsamples of children assessed in each age group. The pattern of results is similar in Figures 3 and 5: both reveal an increase between 2016 and 2022 in the probability of delayed language milestone attainment; both show that the rate of delayed milestone attainment falls as the maternal education level increases; and in both, the gaps between categories of maternal education are greater at ages 2–3 years than at younger ages.

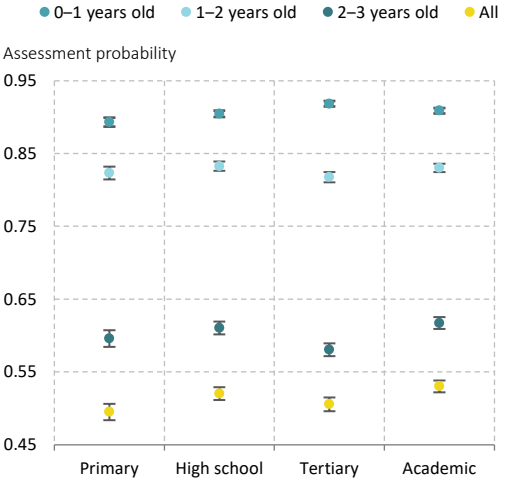
Figure 3. Marginal effect of maternal education level and assessment year on delayed language milestone attainment



Notes: For age brackets 0–1 years N=886,345; 1–2 years N=830,820; 2–3 years N=652,423. The estimates are based on a mixed-effects linear model with random intercept for statistical areas of residence. The vertical bars represent 95% confidence intervals.

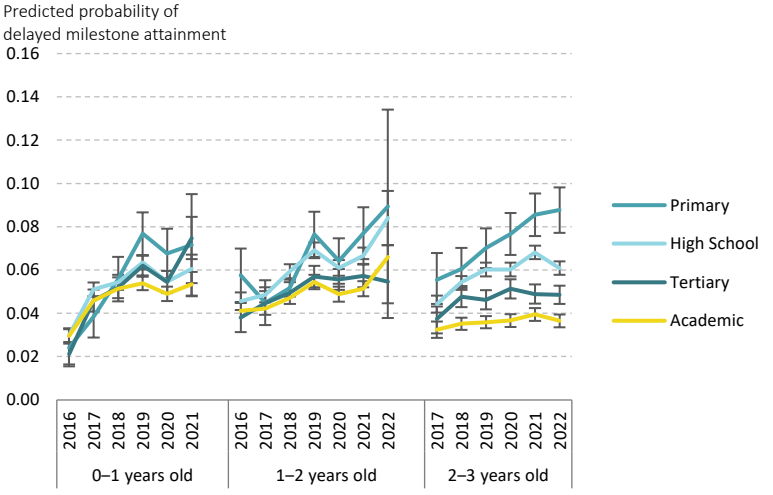
Source: Akiva et al., KI Institute and Taub Center | Data: Ministry of Health, Machshava Briah (Healthy Thinking) dataset

Figure 4. Marginal effect of maternal education level on probability of being assessed by age group



Notes: The estimates are based on logistic regression (logit) models. The vertical bars represent 95% confidence intervals.

Figure 5. Marginal effect of maternal education level and assessment year on delayed language milestone attainment for children with longitudinal assessments



Notes: N=506,205. The vertical bars represent 95% confidence intervals.

Source for both figures: Akiva et al., KI Institute and Taub Center | Data for both figures: Ministry of Health, Machshava Briah (Healthy Thinking) dataset

Discussion

This study has examined trends in Israeli infants' and toddlers' language milestone attainment by maternal education, child's age group, and assessment year. We found a consistently strong relationship between language milestone attainment and maternal education. Maternal education was categorized into four groups: primary school, high school, tertiary education, and academic degree. Each incremental decrease in the level of maternal education was associated with increased rates of children's delayed language milestone attainment. The difference in these rates between the lowest and highest maternal education groups seems to be greater among 2–3-year-olds than among 0–1 and 1–2-year-olds. In addition, there was an overall trend of increased rates of delayed milestone attainment over the assessment years, which was modulated by maternal education: the growth rate of delayed milestone attainment during the observation period among the lower maternal education groups was steeper than the equivalent rate among the higher maternal education groups.

The finding that maternal education is related to infants' and toddlers' emerging language abilities is consistent with previous research showing SES-based gaps in language skills in toddlerhood that widened with increasing age (Fernald et al., 2013; Halle et al., 2009; Noble et al., 2015; Rowe et al., 2012; Rowe & Goldin-Meadow, 2009). With a population-representative sample, we expanded previous findings and found robust evidence of SES gaps in language as early as infancy. We used surveillance of age-appropriate developmental milestones as a benchmark, which involves more rudimentary skills than the ability tests, such as vocabulary assessments, used in other studies. Thus, family SES-based differences in language skills are more entrenched than previously documented: they are evident in milestone attainment during the first year of life, demonstrating that children from low-SES homes are at greater risk of delayed language.

The increased rates over time of delayed milestone attainment in the language domain are a worrying trend. When a nurse notes delayed milestone attainment during a Tipat Halav visit, s/he is required to recommend that the parent seek a further assessment. Delayed milestone attainment is not a diagnostic tool, but it indicates an increased likelihood of developmental delay or disability. The relationship between delayed milestone attainment and developmental delays is evident in the coinciding trends of increased rates in

both phenomena over the past decade. One of the oft-cited explanations for the increased prevalence of developmental delays is heightened awareness. If this were the key explanation then the true prevalence rates were actually constant, but merely uncovered by increased awareness and subsequent diagnoses. However, using data from universal health care screening and a population-representative sample, we found that the rate of delayed language milestone attainment increased from 3.9% in 2016 to 5.3% in 2022, suggesting that the actual percentage of children not developing on track is increasing.

Beyond increased awareness and changes in assessment protocols, there are several potential explanations for the increased rates of delayed milestone attainment over time. Prenatal and perinatal influences, such as maternal age, health, exposure to harmful substances, premature birth, and childbirth complications, may significantly contribute to this increase (Falster et al., 2018). Advances in medical technology improve infant survival rates, but infants facing complications still have an elevated risk of developmental delays (Hee Chung et al., 2020). Environmental and social influences, including poverty, inequality, inadequate nutrition, limited access to education and healthcare, exposure to violence, excessive screen time, and parenting practices, can contribute to delayed developmental milestone attainment (Delvecchio et al., 2020; Madigan et al., 2019; Roos et al., 2019; Takahashi et al., 2023). Increased exposure to environmental toxins is also a noteworthy factor (Davis et al., 2019; Grandjean & Landrigan, 2014). Together, these complex factors underscore the multifaceted nature of the observed trends in increased delays in child development over time, and future research should thoroughly explore the potential relative contribution of each of these influences.

Even more concerning is the different trajectories of delayed language milestone attainment over the observation years by family SES. Among the 2–3-year-old age group, the rate of delayed language milestone attainment in children of mothers in the primary school education group more than doubled over the period studied, from 5% in 2016 to 10.9% in 2022, whereas among children of mothers with academic education, the rate increased from 1.9% to just 3.3% during the same period. Therefore, in addition to the well-documented gaps in language development by family SES, this finding demonstrates that children from low-SES homes are at greater risk of rising delayed development with each passing year.

Limitations and future research

While our study sheds light on the SES-based gaps in language milestone attainment, there are limitations to the current study. First, while using data from the Tipat Halav EHR provided a large-scale dataset, it also limited possible analyses to the variables available in the system. For example, individual-level variables such as family religiosity and income could have provided more information on the family, compared to the neighborhood-based measure of proportion of Haredi residents and to maternal education as the primary measurement of family SES. Second, the THIS developmental scale, used for defining the outcome variable, is a clinical tool, routinely used in the Tipat Halav clinics, rather than a research-oriented tool. The scale is limited in application for research purposes, because the score for each milestone is dichotomous and the number of milestones that are tested differs by age. A more comprehensive tool for developmental assessment could provide a more holistic representation of SES gaps in early language development.

Further, the sample of the population may be biased among children over the age of two years, when compliance with Tipat Halav visits decreases because these visits no longer involve vaccinations — an issue addressed with the robustness checks described in the Results section above. Another potential source of bias is the inclusion in the data sample of visits during the COVID-19 lockdowns in 2020, when the availability of Tipat Halav services was limited and parents often preferred to avoid non-urgent surveillance visits. However, as described in the results, the trend of increased rates of delayed milestone attainment began before 2020, and the slope is relatively stable throughout the observation years, suggesting that the inclusion of Tipat Halav visits conducted during the pandemic did not influence the results.

Regarding future research: In addition to investigating the factors explaining the increasing rates of delayed milestone attainment mentioned earlier, further studies should extend their focus to other developmental domains, such as personal-social and motor skills. Another promising avenue for research involves examining the interplay between family SES and the child's gender in the context of language skill development. Boys and girls typically exhibit different rates of language development, and the impact of family SES on these patterns may vary (Lange et al., 2016; Sudry et al., 2023). A previous study did not find discernible differences in language skills between boys and girls from high-SES backgrounds (Barbu et al., 2015). By contrast, in low-SES

households, boys had weaker language skills than did girls: girls from these households demonstrated intermediate language abilities — higher than their male counterparts from low-SES homes but lower than children from high-SES families. The large scale of the Tipat Halav dataset could provide more details on how gender and family SES influence developing language, both separately and in interaction.

Future research should also delve deeper into sectoral differences in delayed language milestone attainment. Our findings suggest a trend of lower rates of delayed language milestone attainment among Druze children and children who reside in areas with a large Haredi population. These are intriguing findings, deserving of comprehensive research that carefully delineates whether they are an artifact of measurement or a product of discrete behavioral factors. This is clearly beyond the scope of the current study.

Policy recommendations

Israel has a large and growing early childhood population, divided by population groups that are affected differently by poverty rates and inequality (Navon & Bowers, 2023). The current study reveals how differences in family SES influence early childhood language development. This finding has long-lasting implications, as early language skills can dictate subsequent language development, which is an important predictor of formal learning skills that in turn influence future employment and economic outcomes and the future labor market (Durham et al., 2007; Lee & Burkam, 2002; Marks et al., 2006; Merz et al., 2020; Noble et al., 2006; Ritchie & Bates, 2013; Rowe & Goldin-Meadow, 2009; Sirin, 2005; Walker et al., 1994). There are several policy steps that could be taken that would help close the language gap:

Affordable, accessible, high-quality early childhood education and care

Early childhood education and care (ECEC) programs can play a crucial role in narrowing socioeconomic gaps by providing a foundation for learning that contributes to life-course outcomes (Magnuson & Shager, 2010; Tucker-Drob, 2012). Children from low-SES homes often face barriers to accessing high-quality education frameworks, contributing to a persistent cycle of inequality (Vandenbroeck, 2020). High-quality early childhood education has been

shown to foster language, cognitive, and socioemotional development during the most formative years. Therefore, access to ECEC for all children, regardless of family SES, can help level the playing field. In addition, indicators of the quality of the language environment in daycare facilities — such as activities designed to help children understand and use language, and the use of books in teaching activities — predicted children's vocabulary in kindergarten, even when controlling for vocabulary at age three (Hansen & Broekhuizen, 2021).

Israel's ECEC system, unfortunately, is not up to par in quality, affordability, and accessibility. The Ministry of Education's five-year plan to improve the daycare center system does not sufficiently address many of the system's inherent problems, including the worsening manpower crisis (Blank & Silverman, 2023). Economists consider early childhood investment an effective policy strategy as it yields high returns through improved educational attainment, enhanced workforce productivity, and better health and development outcomes, which reduce societal costs associated with interventions (Heckman, 2006). More work is needed to ensure that all Israeli children have access to high-quality early childhood education, which can benefit both the children and society at large.

Support of Tipat Halav as an important equalizing health institution

The Tipat Halav system has been in a bureaucratic limbo state since the implementation of the National Health Insurance Law in 1995, which made it unclear whether responsibility for its operation lies with the health funds or the Ministry of Health. Today, the Ministry of Health oversees all Tipat Halav clinics, yet operates only approximately two-thirds of the clinics that young Israeli children visit, which were the majority of the sample in the current study. Funding and regulatory uncertainties have held back progress. For example, due to the ongoing lack of clarity regarding responsibility for operation of the system, there is no clear regulatory mechanism for updating various aspects of the clinics, including staffing, salaries, and provided services, including new vaccinations. This has led to neglect of needed investment and development. The current state of the Tipat Halav system is unfortunate, as it exemplifies a population- and a community-centric approach and reaches nearly all Israeli families with young children.

Our findings underscore the crucial role of Tipat Halav as an institution with the potential to be a remarkable resource for preventative health, health promotion, and improvement child developmental outcomes, emphasizing its significance as a primary resource for the Ministry of Health, particularly in the early detection of developmental issues and initiating prompt interventions. We recommend bolstering the Tipat Halav system, especially considering its strong standing within low-SES populations — notably among the Arab population, who demonstrate greater reliance and trust in Tipat Halav services than in daycare attendance. Leveraging Tipat Halav's widespread acceptance, educational initiatives within the system could effectively cater to the specific needs of children requiring additional support, in alignment with cultural norms, thus ensuring broader outreach and impact.

Given the rise in rates of delayed milestone attainment, one strategy that could bolster the Tipat Halav system and improve children's developmental outcomes would be to bring together the developmental monitoring services provided by the Tipat Halav clinics with other clinical and health professional services provided in child development clinics, under one roof. These are currently separate systems, and integrating them would ensure continuity of care and increase the likelihood that children identified with delayed milestone attainment would receive the necessary diagnostic evaluation follow-up. Ease of access to health services at Tipat Halav clinics could be beneficial to everyone, but particularly for lower SES families who are at greater risk for developmental delays and have fewer resources for accessing professional health services.

The Ministry of Health's oversight of the Tipat Halav system takes on heightened importance in today's era of data-driven healthcare policy. The Ministry of Health's management of the unique THIS dataset facilitates national monitoring of child development, enabling the creation of tailored tools for early detection and personalized interventions as necessary. This control is crucial in leveraging big data for informed, effective healthcare strategies that cater to individual child development needs.

Conclusion

This study delves into language milestone attainment trends among Israeli infants and toddlers by family SES, measured by maternal education. A consistent relationship emerges between maternal education and language milestone attainment: lower levels of maternal education were associated with higher rates of delayed language milestone attainment in infancy, with a more pronounced disparity among 2–3-year-old children. Notably, rates of delayed milestone attainment rise over assessment years, particularly within lower maternal education groups. The escalating trends of delayed language milestones and widening gaps by family SES are deeply concerning. Future research should explore potential explanations for these trends, such as prenatal influences, environmental factors, and technological advancements. Investing in quality early childhood public education can serve as a crucial equalizer, offering all young children exposure to a language-rich environment. Furthermore, the study underscores the pivotal role of Tipat Halav in public preventative health, emphasizing the need for its fortification to ensure that more children will benefit from its services.

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Appendix

Appendix Table 1. Demographic characteristics by age group

Age	0–1 years	1–2 years	2–3 years
n	886,345	830,820	652,423
Maternal education			
Primary	16,286 (1.8%)	15,842 (1.9%)	12,879 (2.0%)
High school	222,887 (25.1%)	215,250 (25.9%)	174,099 (26.7%)
Tertiary education	95,352 (10.8%)	85,215 (10.3%)	62,925 (9.6%)
Academic	257,694 (29.1%)	246,040 (29.6%)	200,488 (30.7%)
Missing	294,126 (33.2%)	268,473 (32.3%)	202,032 (31.0%)
Population group			
Christian Arab	11,481 (1.3%)	11,438 (1.4%)	10,149 (1.6%)
Druze	12,924 (1.5%)	12,947 (1.6%)	11,696 (1.8%)
Jewish	529,283 (59.7%)	491,548 (59.2%)	375,691 (57.6%)
Muslim Arab	171,452 (19.3%)	168,481 (20.3%)	144,663 (22.2%)
Bedouin	16,333 (1.8%)	12,130 (1.5%)	7,486 (1.1%)
Other	18,708 (2.1%)	18,214 (2.2%)	14,947 (2.3%)
Missing	126,164 (14.2%)	116,062 (14.0%)	87,791 (13.5%)
Sex of child			
Female	430,331 (48.6%)	403,774 (48.6%)	316,720 (48.5%)
Male	456,014 (51.4%)	427,046 (51.4%)	335,703 (51.5%)
Maternal country of birth			
Ethiopia	13,215 (1.5%)	12,537 (1.5%)	9,938 (1.5%)
FSU	48,377 (5.5%)	47,472 (5.7%)	38,671 (5.9%)

Appendix Table 1 (continued). Demographic characteristics by age group

Age	0–1 years	1–2 years	2–3 years
Maternal country of birth (continued)			
Israel	694,865 (78.4%)	655,474 (78.9%)	519,694 (79.7%)
Other	33,073 (3.7%)	30,462 (3.7%)	23,009 (3.5%)
Missing	96,815 (10.9%)	87,875 (10.2%)	61,111 (9.4%)
Maternal employment status			
Student	36,752 (4.1%)	33,959 (4.1%)	26,580 (4.1%)
Employed	406,679 (45.9%	372,051 (44.8%)	286,165 (43.9%)
Unemployed	166,052 (18.7%)	162,319 (19.5%)	132,649 (20.3%)
Missing	276,862 (31.2%)	262,491 (31.6%)	207,029 (31.7%)
Maternal marital status			
Married	738,045 (83.3%)	700,372 (84.3%)	557,843 (85.5%)
Unmarried	29,429 (3.3%)	27,087 (3.3%)	20,522 (3.1%)
Divorced	8,470 (1.0%)	8,614 (1.0%)	7,189 (1.1%)
Missing or other	110,401 (12.5%)	94,747 (11.4%)	66,869 (10.2%)
Maternal age			
20 and under	30,034 (3.4%)	29,402 (3.5%)	24,439 (3.7%)
21–40	775,325 (87.5%)	734,351 (88.4%)	582,807 (89.3%)
Over 40	27,666 (3.1%)	25,282 (3.0%)	19,331 (3.0%)
Missing	53,320 (6.0%)	41,785 (5.0%)	25,846 (4.0%)
Gestational age (weeks)			
Less than 28	1,425 (0.2%)	1,413 (0.2%)	1,098 (0.2%)
28–31	4,893 (0.6%)	4,768 (0.6%)	3,804 (0.6%)

Appendix Table 1 (continued). Demographic characteristics by age group

Age	0–1 years	1–2 years	2–3 years
Gestational age (weeks) (continued)			
32–36	56,407	53,638	42,418
	(6.4%)	(6.5%)	(6.5%)
37 and over	815,407	748,638	589,396
	(92.0%)	(91.3%)	(90.3%)
Missing	8,213	12,363	15,707
	(0.9%)	(1.5%)	(2.4%)
Birth weight (kg)			
Under 2.5	63,414	60,512	48,312
	(7.2%)	(7.3%)	(7.4%)
2.5–4.0	770,138	716,516	558,139
	(86.9%)	(86.2%)	(85.5%)
Over 4.0	43,485	40,423	31,119
	(4.9%)	(4.9%)	(4.8%)
Missing	9,308	13,369	14,853
	(1.1%)	(1.6%)	(2.3%)

Source: Akiva et al., KI Institute and Taub Center | Data: Ministry of Health, Machshava Briah (Healthy Thinking) dataset

Appendix Table 2. Regression table predicting delayed language milestone attainment

	0–1 years		1–2 years		2–3 years	
	Est.	S.E.	Est.	S.E.	Est.	S.E.
Maternal education (reference: Academic)						
Primary	−0.007	0.004	0.007	0.004	0.016**	0.005
High school	−0.001	0.002	0.004*	0.001	0.013***	0.002
Tertiary	−0.010***	0.002	0.000	0.002	0.010***	0.003
Missing	0.000	0.001	0.001	0.001	0.011***	0.002
Maternal employment (reference: Employed)						
Unemployed	0.008***	0.001	0.009***	0.001	0.018***	0.001
Student	0.000	0.001	−0.002	0.001	−0.003**	0.001
Missing	0.003***	0.001	0.000	0.001	0.003***	0.001

Appendix Table 2 (continued). Regression table predicting delayed language milestone attainment

	0–1 years		1–2 years		2–3 years	
	Est.	S.E.	Est.	S.E.	Est.	S.E.
Maternal marital status (reference: Married)						
Divorced	0.009***	0.002	0.023***	0.002	0.030***	0.002
Unmarried	−0.002	0.001	0.017***	0.001	0.025***	0.001
Missing or other	−0.001	0.001	0.000	0.001	0.003**	0.001
Population group (reference: Jewish)						
Christian Arab	−0.009***	0.003	−0.023***	0.003	−0.018***	0.002
Muslim Arab	−0.002	0.001	−0.014***	0.001	−0.002	0.001
Bedouin	−0.002	0.002	−0.015***	0.002	0.001	0.003
Druze	−0.016***	0.004	−0.033***	0.004	−0.017***	0.004
Other	−0.004*	0.002	0.011***	0.002	0.045***	0.002
Missing	−0.001	0.001	0.000	0.001	0.002	0.001
Maternal age (reference: 21–40-years-old)						
20 and under	−0.006***	0.001	−0.009***	0.001	−0.006***	0.001
Over 40	0.008***	0.001	0.011***	0.001	0.014***	0.002
Missing	−0.004*	0.001	−0.004**	0.002	−0.006***	0.002
Pregnancy week (reference: 37 and over)						
Under 28	0.302***	0.006	0.364***	0.006	0.138***	0.006
28–31	0.195***	0.003	0.151***	0.003	0.053***	0.004
32–36	0.074***	0.001	0.028***	0.001	0.013***	0.001
Missing	−0.001	0.005	0.006	0.004	−0.002	0.003
Birthweight (reference: 2.5–4.0 kg)						
Under 2.5 kg	0.048***	0.001	0.028***	0.001	0.018***	0.001
Over 4.0 kg	−0.008***	0.001	−0.005***	0.001	0.000	0.001
Missing	−0.001	0.005	−0.004	0.004	−0.005	0.004
Apgar (reference: 8 and over)						
Apgar 1 min < 8	0.009***	0.001	0.011***	0.001	0.009***	0.001
Missing Apgar 1 min	0.003	0.003	0.000	0.003	0.001	0.003
Apgar 5 min < 8	0.018***	0.003	0.023***	0.003	0.012***	0.003
Missing Apgar 5 min	−0.002	0.003	0.006*	0.003	0.005	0.003
Birth type (reference: Vaginal)						
Assisted delivery	−0.005***	0.001	−0.001	0.001	−0.002	0.001
Cesarean section	0.012***	0.001	0.010***	0.001	0.009***	0.001
Missing	−0.007*	0.004	−0.012***	0.002	0.003*	0.001

Appendix Table 2 (continued). Regression table predicting delayed language milestone attainment

	0–1 years		1–2 years		2–3 years	
	Est.	S.E.	Est.	S.E.	Est.	S.E.
Sex of child (reference: Female)						
Male	0.002***	0.000	0.021***	0.000	0.030***	0.001
Examination year (reference: 2016)						
2017	0.016***	0.002	0.008***	0.002	0.006**	0.002
2018	0.022***	0.002	0.014***	0.002	0.007***	0.002
2019	0.025***	0.002	0.023***	0.002	0.007***	0.002
2020	0.021***	0.002	0.016***	0.002	0.008***	0.002
2021	0.029***	0.002	0.018***	0.002	0.011***	0.002
2022	0.017***	0.002	0.015***	0.002	0.008***	0.002
Socioeconomic cluster (reference: Cluster 10 — the highest)						
Cluster 1	0.039**	0.013	0.014	0.012	0.020*	0.008
Cluster 2	0.029***	0.008	0.024**	0.008	0.037***	0.006
Cluster 3	0.034***	0.007	0.030***	0.007	0.045***	0.005
Cluster 4	0.041***	0.007	0.036***	0.007	0.053***	0.005
Cluster 5	0.031***	0.007	0.035***	0.007	0.042***	0.005
Cluster 6	0.032***	0.007	0.033***	0.007	0.034***	0.005
Cluster 7	0.025***	0.007	0.021**	0.007	0.023***	0.005
Cluster 8	0.019**	0.007	0.008	0.007	0.013**	0.005
Cluster 9	0.009	0.008	0.001	0.007	0.000	0.005
Jewish ultra-Orthodox rate (reference: None)						
Very high	0.012**	0.004	−0.018***	0.004	−0.039***	0.003
High	0.002	0.006	−0.020***	0.006	−0.027***	0.004
Medium	−0.001	0.005	−0.013**	0.005	−0.017***	0.003
Low	−0.004	0.003	−0.006*	0.003	−0.006*	0.002
Education × Examination year						
Primary × 2017	−0.003	0.006	−0.004	0.006	0.009	0.007
High school × 2017	0.005*	0.002	0.003	0.002	0.001	0.003
Tertiary × 2017	0.008*	0.003	0.002	0.003	−0.001	0.004
Missing × 2017	−0.003	0.002	0.001	0.002	−0.005	0.002
Primary × 2018	0.009	0.006	0.000	0.006	0.014	0.007
High school × 2018	0.004	0.002	0.008***	0.002	0.007*	0.003
Tertiary × 2018	0.011***	0.003	0.002	0.003	0.002	0.004
Missing × 2018	0.004*	0.002	0.006**	0.002	0.002	0.002

Appendix Table 2 (continued). Regression table predicting delayed language milestone attainment

	0–1 years		1–2 years		2–3 years	
	Est.	S.E.	Est.	S.E.	Est.	S.E.
Education × Examination year (continued)						
Primary × 2019	0.022***	0.006	0.011	0.006	0.018**	0.007
High school × 2019	0.011***	0.002	0.010***	0.002	0.011***	0.003
Tertiary × 2019	0.018***	0.003	0.002	0.003	−0.001	0.004
Missing × 2019	0.009***	0.002	0.006**	0.002	0.004	0.002
Primary × 2020	0.021**	0.007	0.010	0.006	0.026***	0.007
High school × 2020	0.007**	0.002	0.009***	0.002	0.011***	0.003
Tertiary × 2020	0.018***	0.003	0.007*	0.003	0.004	0.004
Missing × 2020	0.005*	0.002	0.010***	0.002	0.005*	0.003
Primary × 2021	0.020**	0.007	0.025***	0.006	0.031***	0.007
High school × 2021	0.007**	0.002	0.011***	0.002	0.016***	0.003
Tertiary × 2021	0.022***	0.003	0.006*	0.003	−0.001	0.004
Missing × 2021	0.006**	0.002	0.008***	0.002	0.005	0.003
Primary × 2022	0.027***	0.006	0.025***	0.006	0.034***	0.007
High school × 2022	0.005*	0.002	0.009***	0.002	0.011***	0.003
Tertiary × 2022	0.013***	0.003	0.004	0.003	0.001	0.004
Missing × 2022	0.005*	0.002	0.010***	0.002	0.006*	0.003
No of observations	886,345		830,820		652,423	
R^2 Marg.	0.031		0.023		0.024	
R^2 Cond.	0.056		0.049		0.036	
AIC	−165602.9		−199815.0		−237532.5	
BIC	−164667.3		−198884.6		−236621.5	
ICC	0.0		0.0		0.0	
RMSE	0.22		0.21		0.20	

Significance levels: *p < 0.05; **p < 0.01; ***p < 0.001.

Source: Akiva et al., KI Institute and Taub Center | Data: Ministry of Health, Machshava Briah (Healthy Thinking) dataset