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RESEARCH PAPER

Child growth and refugee status: evidence from Syrian migrants in Turkey

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Abstract

This study examines disparities in health and nutrition among native and Syrian refugee children in Turkey. To understand the need for targeted programs addressing child well-being among the refugee population, we analyze the Turkey Demographic and Health Survey (TDHS) – which provides representative data for a large refugee and native population. We find no evidence of a difference in infant or child mortality between refugee children born in Turkey and native children. However, refugee infants born in Turkey have lower birthweight and age-adjusted weight and height than native infants. When we account for a rich set of birth and socioeconomic characteristics that display substantial differences between natives and refugees, the gaps in birthweight and age-adjusted height persist, but the gap in age-adjusted weight disappears. Moreover, the remaining gaps in birthweight and anthropometric outcomes are limited to the lower end of the distribution. The observed gaps are even larger for refugee infants born before migrating to Turkey, suggesting that the remaining deficits reflect conditions in the source country before migration rather than deficits in access to health services within Turkey. Finally, comparing children by the country of their first trimester, we find evidence of the detrimental effects of stress exposure during pregnancy.

Keywords: Syrian refugees; birthweight; anthropometric measures; forced displacement; Turkey

JEL codes: J61; O15; I12; I18; F22

1. Introduction

Almost 1% of the world population was categorized as forcibly displaced as of the end of 2011. The number of forcibly displaced people worldwide has also been increasing; it has more than doubled from 2011 to 2021, according to the UNHCR (2022). Of the 89.3 million forcibly displaced people worldwide at the end of 2021, 27.1 million were refugees, 4.4 million were Venezuelans displaced abroad, and 4.6 million were asylum seekers. About 41% of the forcibly displaced population worldwide are children under 18 (UNHCR, 2022). Of the refugees, including displaced Venezuelans, 83% were hosted in low- and middle-income countries. Syria is the top source country, producing 27% of all refugees, and Turkey is the top destination country hosting 3.8 million refugees – most of whom are Syrians.

A less recognized feature of the Syrian population in Turkey is that a relatively large fraction of refugees are young. According to the Turkish Presidency of Migration Management (TPMM, 2022), 48.8% of Syrian refugees in Turkey were 18 or younger as of November 2022. The figures are comparable to what is observed in sub-Saharan Africa, reflecting both higher fertility and differential migration of families with children. Given the potential implications for long-term labor force participation as well as overall concerns for well-being, a substantial amount of scholarly attention has been focused on the provision of schooling to children. Through a process of community rather than camp settlement and the integration of refugees into the public school system, Turkey has had considerable success in ensuring schooling access to refugee children (Kirdar *et al.*, 2023).

A singular focus on educational attainment among refugees, however, may not sufficiently account for the consequences of possible nutritional deficits in utero and early childhood. An extensive body of literature shows that access to quality nutrition may be an important complement to investments in education. Much of this literature focuses on the correlates of low body size, including birthweight, which is importantly influenced by both nutritional intake and exposure to disease. The medical literature finds that birthweight is strongly associated with mortality during the first year (Luke *et al.*, 1993; Wilcox, 1993). In meta-analyses of studies from developing countries, Pelletier (1994) and McDonald *et al.* (2013) find that anthropometric deficits are also associated with child mortality. Other studies report that low birthweight is associated with adverse cognitive and health outcomes later in life (e.g., Barker, 1995; Godfrey & Barker, 2000; Steffensen *et al.*, 2000). Almond *et al.* (2005) find that low birthweight also leads to higher medical costs. A growing literature in economics also establishes causal effects of birthweight using sibling or twin fixed effects (Behrman & Rosenzweig, 2004; Black *et al.*, 2007; Conley & Bennett, 2000; Figlio *et al.*, 2014). These studies find birthweight effects on school attainment, adult height, IQ, and earnings. Almond *et al.* (2018) review this literature and conclude that mild shocks in early life can indeed have substantial negative impacts both in the short and long run.

Despite the evidence of the consequences of poor nutrition in infancy and early childhood, considerably less attention has been given to possible nutritional deficits of refugee children. This weakness in the literature is, in some ways, understandable. In contrast to education, which is more or less directly under the control of the public sector, nutritional allocations to refugee (and other) children are largely governed by household behavior given resource availability. Nutrition and health behaviors are thus less directly subject to policy manipulation and also may be more difficult to evaluate or measure.

There is, of course, a literature that examines health differences between natives and economic migrants. However, the literature on the gaps between natives and refugees in child health is much more limited. Refugees differ from economic migrants regarding mother and child health in several important ways. First, refugees go through the traumatic effects of conflict and forced migration. These events could have long-term impacts on women's health, affecting their future infants' health. They could also affect pregnancies of women and infants exposed directly to conflict and the forced migration process (see, e.g., Camacho, 2008; Mansour & Rees, 2012). Second, refugees – fleeing war and forced to leave their jobs and part of their wealth at their origin – generally live in worse socioeconomic conditions and have poorer labor market outcomes than economic migrants and natives in the host countries (see, e.g., Demirci & Kirdar [2023] for Syrian refugees in Turkey and Brell *et al.* [2020] for refugees in Europe). Third, while economic migrants are often selected positively based on education and health (see, e.g., Florian *et al.*, 2021), the selection is less likely to be positive for refugees fleeing a war. Finally, refugees might also face institutional barriers to accessing health services.

This paper uses the Turkey Demographic and Health Survey (TDHS) to assess the extent of nutritional and health-behavior deficits among refugee children. The 2018 round of the TDHS is the first dataset including birthweight and anthropometric measures for a nationally representative sample of native and Syrian-refugee children. This dataset also contains a rich set of socioeconomic characteristics that can be used to separate the direct refugee effects from the differences arising from disparities in socioeconomic conditions between natives and refugees. In addition, the dataset provides a rich set of outcomes on health behavior, including prenatal and postnatal care, vaccination, breastfeeding, and nutrition – which may help us interpret any observed differences in child health outcomes.

We find no evidence of a difference in infant or child mortality between refugee children born in Turkey and native children. However, refugee infants born in Turkey have lower birthweight and age-adjusted weight and height than native infants. When we account for a rich set of birth and socioeconomic characteristics, the gaps in birthweight and age-adjusted height persist, but the gap in age-adjusted weight disappears. Although refugee infants close the weight gap at the mean over time, the gap at the lower end of the distribution persists. The rich set of covariates we use explains about 35% of the baseline difference in birthweight and more than half of the baseline difference in age-adjusted height. However, even conditioning on these characteristics, refugee infants' average birthweight is 0.17 standard deviations (SD) lower and their age-adjusted height is 0.23 SD lower. These gaps are even larger for refugee infants born outside Turkey.

The differences between refugees born in Turkey and natives in birthweight and anthropometric outcomes are limited to the lower end of the distribution. No native–refugee gap exists above the mean level for any of the outcomes. After accounting for the covariates, refugee infants born in Turkey are 4.8 percentage points (pp) more likely to have low birthweight, 2.4 pp more likely to be underweight and 6.0 pp more likely to be stunted; however, they are not less likely to have high birthweight or be overweight or tall.

Differences in prenatal care behavior exist between native and refugee mothers even after accounting for the discrepancies in socioeconomics. These differences in prenatal care behavior explain a further 30% and 11% of the remaining gaps in birthweight and age-adjusted height, respectively. Although refugees are less likely to take postnatal care, this difference does not help explain any residual gaps in anthropometric outcomes. No gap exists in vaccination behavior between natives and refugees after accounting for the covariates. However, the two groups display significant differences in breastfeeding and nutritional behavior.

Studies examining differences in child health between natives and refugees in low- and middle-income countries reach mixed results. Moss *et al.* (1992), using a small sample of Guatemalan and Salvadoran migrant children and Belizean natives, find that the gap in weight for age vanishes once socioeconomic differences are accounted for. Comparing Mozambican refugees and South African natives in a rural sub-district of South Africa, Hargreaves *et al.* (2004) report gaps in child mortality. Abdulrahim *et al.* (2019), using data from 31 Lebanese hospitals, find slightly lower birthweights for Syrian refugees than natives. Singh *et al.* (2005) find no difference in under-five mortality between Sudanese refugees and natives in Uganda. For Palestinian refugee children living in Jordan and Lebanon, Khawaja (2004) finds similar or lower infant and child mortality levels compared to their native counterparts. In contrast, the studies that analyze the child health gap between natives and refugees in the context of high-income Scandinavian countries generally report worse outcomes for refugee children (Dunlavy *et al.*, 2023; Liu *et al.*, 2019; Norredam *et al.*, 2012).[1]

Our study differs from the above refugee contexts in low- and middle-income countries in that it is based on a nationally representative dataset. Most of the above studies cover refugees in rural or camp settings, whereas the refugees in our study are urban residents. In addition, while the above studies focus on one issue (either mortality, birthweight, or weight for age), we provide a more comprehensive analysis of child health and growth, including mortality, birthweight, and anthropometric outcomes. Moreover, we analyze how health behavior relates to these findings.

An important contribution of our study is that it includes a careful investigation of how the gaps vary across the distribution of each outcome. We conduct a more nuanced and innovative analysis of the anthropometric gaps by summarizing the distributions using a hazard rate, most commonly applied in the analysis of duration data. The advantage of a hazard approach for examining distribution effects is that an increased hazard at low levels of the outcome does not impose restrictions at higher levels.

Finally, we also examine how exposure to war in Syria during pregnancy affects birthweight and anthropometric measures of refugee children. First, we examine whether Syrian women's birth propensity changes after they arrive in Turkey to assess any compositional impacts. We find no statistical evidence for arrival in Turkey changing the birth propensity. Then, we compare refugee children born in Turkey according to the country in which they spent their first trimester (Syria vs. Turkey) and find adverse effects of the war on anthropometric outcomes. This finding is similar to that of earlier studies estimating the causal effects of stress exposure during pregnancy (see, e.g., Camacho, 2008; Guantai & Kijima, 2020; Mansour & Rees, 2012; Torche, 2011; Tsujimoto & Kijima, 2020). These studies examine the impact of conflict using geographical variation in conflict intensity across regions. In our setting, the population of interest is different in the way that we examine it for a group of refugees, and we find that the host country for refugees provides a safer environment during pregnancy.

2. Brief background information

Refugees started arriving in Turkey as early as April 2011 after the civil war in Syria began. The Turkish government implemented an open-door policy for the refugee

[1]A related literature examines the effects of internal forced displacement on child health. Comparing internally displaced Rwandans with those who were not, Verwimp and van Bavel (2005) find higher mortality rates among children whose families were subject to forced migration. Avogo and Agadjanian (2010) find disadvantages for forced migrants relative to non-migrants in all outcomes but morbidity and immunization.

population and gave the Syrian refugees temporary residence permits mainly for health, work, and schooling purposes. The pace of the refugees' arrival gained momentum in 2013 as the war enraged. The number of refugees reached 2.5 million at the end of 2015 and 3.6 million at the end of 2018. Most refugees live in urban areas; according to the TDHS-2018, the share of refugees residing in camps was 4.3%.

In terms of demographics, Syrians are younger, less educated, and poorer than natives (Kirdar *et al.*, 2023). Although the paid employment rate of Syrian men is not much lower than that of natives, the majority work in the informal sector (Demirci & Kirdar, 2023). WFP (2016) reports that 28.6% of Syrian refugees residing outside camps were food insecure and 93% were below the poverty line.

Before they arrived in Turkey, Syrian mothers and children faced poor health conditions in Syria. The civil war caused substantial destruction to the health care infrastructure in Syria and public health challenges – including serious maternal and child health problems. WHO (2013) reports that in 2013, 2 years after the start of the civil war, at least 35% of the country's public hospitals were out of service, and 70% of the health workforce in some provinces left the country.

Turkey implemented a generous health care policy toward Syrian refugees. Registered Syrian refugees have universal health coverage, and health care services offered to Syrian refugees with this coverage are the same as the health services provided to the native population. Essentially, all Syrian refugees in Turkey can use preventive and emergency services for free, and registered refugees have access to public primary, secondary, and tertiary health care services free of charge.

Turkey's health care system displays the characteristics of an average upper-middle-income country. Aygün *et al.* (2021) report that the number of physicians, nurses, midwives, and nurses per 1,000 in Turkey in 2011 (before the refugees started arriving) was close to the corresponding averages for upper-middle-income countries. The infant mortality rate in Turkey was 13.9 per 1,000 births in 2011, also similar to the average level for upper-middle-income countries (15.0).

Figure 1 compares birthweight and anthropometric outcomes in Syria and Turkey before the war using the TDHS-2008, the 2009 Syria Family Health Survey (SFHS), and the 2006 Syria Multiple Indicator Cluster Survey. Panel (A) shows that birthweight distributions in Syria and Turkey before the war were highly similar. However, panel (B) displays small differences in height and weight by age in favor of Turks over Syrians. These minor differences imply that the significant gaps we report between natives and refugees based on the TDHS-2018 do not result from pre-existing conditions.

3. Data and empirical strategy

The TDHS is conducted every 5 years. The survey collects detailed information about women's demographic characteristics and fertility history and several measures of child health and growth. In this study, we use the 2018 round of TDHS – which includes a representative sample of Syrian refugees residing in Turkey, in addition to the native sample. The first module of the survey, known as the household roster data, collects the essential demographic characteristics of each member of the visited house. The second module of the survey gathers more detailed information about marriage and fertility history as well as child and women's health for the sample of household members who are 15–49-year-old women.

Figure 1. Pre-war values of birthweight and anthropometric outcomes in Turkey and Syria.

We focus on children of 15–49-year-old mothers in the survey. We observe several anthropometric measures in the data for each child born in the last 5 years preceding the survey, including birthweight, current height, current weight, and current weight for height. Birthweight is measured in grams. We use both this measure and its standardized *z*-score.[2] In addition, we use age-specific (measured in days) standardized versions of the current weight, height, and weight for height. These standardizations are based on the corresponding mean and SD statistics obtained from the WHO (World Health Organization);[3] therefore, they provide the WAZ (weight-for-age *z*-score), the HAZ (height-for-age *z*-score), and the WHZ

[2]We standardize birthweight based on its sample average and sample standard deviation for all infants in the data.

[3]While we generate the standardized birthweight variable, standardized HAZ, WAZ, and WHZ are available in the dataset. With this standardization, the WHO aims to convert the distribution of current height, weight, and height for weight in each age (measured in days) to be distributed as approximately

(weight-for-height z-score) measures as commonly referred in literature. The dataset also provides a rich set of control variables detailed below. To understand the effect of refugee status on birthweight and anthropometric measures of children, we estimate the following equation.

$$y_i = \alpha_1 + \beta_1 \times \text{refugee}_i + \boldsymbol{X}_i^{'} \Gamma_1 + u_i, \quad (1)$$

where y_i denotes the anthropometric measure of interest for child i. We analyze five outcomes: birthweight in grams, standardized birthweight in z-scores, WAZ, HAZ, and WHZ. We measure the refugee status with the binary variable, refugee$_i$, and the key coefficient of interest in equation (1) is its coefficient, β_1. This coefficient shows the effect of the refugee status on the outcome of interest compared to natives, holding other covariates constant. In the equation, $\boldsymbol{X}_i^{'}$ denotes the vector of covariates and u_i is the error term for child i.

We observe the refugee status of mothers in the data, and the variable refugee$_i$ takes the value of 1 for the infants born to refugee mothers. As explained later, we also differentiate refugee infants as those born in Turkey and others. While the county of birth is available in the data;[4] in an alternative analysis, we infer it from women's birth and migration histories, both of which are available in year-month format. Also, we use the migration history to identify the country of contraception and first trimester.

The vector $\boldsymbol{X}$ includes a wide set of control variables. We group these variables into six categories and add them into the regressions sequentially. We define each group as follows: (1) *birth characteristics* including dummies for the baby's sex, birth order, and twin status (single, twin, or triplet), the time passed since last birth (less than 18 months, 19–24 months, 25–30 months, 31–36 months, and more than 36 months), mother's age at birth (ages 13–15, 16–18, 19–21, 22–25, 26–30, 31–35, 36–39, 40–43, and 44–49), and the duration of pregnancy in months; (2) *mother characteristics* including dummies for mother's education (no education, incomplete primary, complete primary, incomplete secondary, complete secondary, incomplete high school, and high school or more) and smoking status (never, irregularly smoke, and regularly smoke); (3) *mother size* including her height and body mass index; (4) *environmental characteristics* including dummies for the birth region (at the NUTS-1 level), type of birth place (province center, district center, and village), and access to safe water and safe sanitation; (5) *household characteristics* including dummies for each household size value, household head's sex, and partner's education categories; and (6) *household wealth* in the form of quintile dummies. For all control variables, we use a separate dummy variable for missing status whenever needed.

We also estimate equation (1) as a linear probability model for indicators of specific categories of anthropometric outcomes of interest. In particular, we analyze whether the baby has a low birthweight (less than 2,500 g) or high birthweight (more than 4,000 g),

normal with the mean 0 and the variance 1 for all children in a healthy reference population around the world.

[4]We obtain the county of birth from the household roster by merging it with the data module focusing on women. For a small group of refugee infants who were currently not alive or did not live with their mother at the survey time (60 refugee infants), we do not have the information about their country of birth. We infer their birthplace by comparing the infants' birth year with the year of their mothers' arrival in Turkey.

whether the child is underweight (WAZ is lower than −2) or overweight (WAZ is higher than 2), whether the child is stunted (HAZ is lower than −2) or tall (HAZ is higher than 2), and whether the child is wasted (WHZ is lower than −2) or overweight (WHZ is higher than 2).

The TDHS also elicits information about access to health care in the prenatal and postnatal period, vaccination, breastfeeding, and nutritional take-in for subsets of children. We use this information for two purposes. First, we explore whether native and refugee children differ in access to health care or nutritional support. For this purpose, we estimate equation (1) with health care or nutritional measures as the dependent variable. Second, we assess how the gap in each anthropometric measure of interest changes after controlling for these variables. We estimate this using the following specification

$$y_i = \alpha_2 + \beta_2 \times \text{refugee}_i + \boldsymbol{X}_i^{'}\Gamma_2 + \boldsymbol{Z}_i^{'}\Pi + \nu_i. \tag{2}$$

The vector $\boldsymbol{Z}$ stands for a single group of five different groups of health care or nutrition related control variables. In other words, we examine how β_2 changes with the inclusion of each group separately. These five groups are regarding (i) prenatal care, (ii) postnatal care, (iii) breastfeeding, (iv) vaccination, and (v) nutrition.

First, the set of *prenatal care* characteristics includes dummies for whether any prenatal care is received, whether the number of prenatal care visits is four or more (the minimum number of visits suggested by health authorities in Turkey), whether iron tablets are taken during pregnancy, whether the prenatal care is given by a health care specialist (a doctor, nurse, or midwife), whether the care is given at a health care facility (hospital, maternity house, family or migrant health center), whether the first visit is in the first, second, or third trimester, and dummies for various pregnancy health checks. Second, the set of *postnatal care* characteristics includes dummies for whether a postnatal check is received, whether the postnatal check is received within the first month after delivery, whether the place of the care is a health care facility, and whether a health care specialist gives the care. Third, the set of *breastfeeding* characteristics includes dummies for the time of starting breastfeeding (started within an hour after the delivery or not) and the status of breastfeeding by age.[5] Fourth, *vaccination* characteristics include dummy variables indicating whether the child is fully vaccinated. Finally, *nutritional* characteristics consist of dummies for protein intake and baby formula or milk product intake by age. Children who ate milk, yogurt, or cheese in the last 24 h preceding the survey are considered to have consumed a milk product. Children who ate an egg, meat, chicken, or fish in the last 24 h preceding the survey are considered to have consumed protein. Details of the prenatal care, vaccination, breastfeeding, and nutritional characteristics are provided in the online Data Appendix.

Since the TDHS includes information on birthweight and the anthropometric measures of children born in the last 5 years preceding the survey, our analysis focuses on this group of children. We also restrict the refugee sample to children

[5]The main reason we control for the status of breastfeeding in the first hour is that the WHO recommends it. In fact, several studies report that breastfeeding within the first hour of life is related to a lower risk of infection and neonatal death due to sepsis, pneumonia, diarrhea, and hypothermia (see, e.g., Edmond *et al.* 2006; Khan *et al.* 2015; Victora *et al.* 2016). Khan *et al.* (2015) conduct a systematic review and meta-analysis.

born in Turkey. We adopt this restriction because we observe the full set of control variables for this group. Nonetheless, we also analyze an alternative sample that also includes refugee infants born outside of Turkey by employing a narrower set of control variables.

We estimate equation (1) using the full sample of children born within the last 5 years to the women in our sample when the dependent variable is birthweight, HAZ, WAZ, or WHZ. However, the data force us to use smaller samples to estimate equations (1) and (2) when we utilize health care or nutrition-related outcomes because the prenatal care, postnatal care, and breastfeeding characteristics are available only for the most recent child delivered by each woman in the previous 5 years and the vaccination and nutritional outcomes are available only for children born within the last 3 years preceding the survey.

4. Empirical results

4.1 Descriptive statistics

Table 1 compares the birthweight and anthropometrics of native and refugee children born in Turkey. Refugee infants weigh almost 200 g less at birth than native infants, and their birthweight is 0.26 SD lower. The native–refugee gap is more acute in HAZ (0.48 SD) than in WAZ (0.16 SD). Hence, the mean WHZ is higher for refugees than natives. In addition, the smaller native–refugee gap in WAZ than birthweight (0.16 vs. 0.26 SD) suggests that the difference in birthweight narrows over time.

When we examine the birthweight distribution in more detail, we observe that the difference exists at the median and lower percentiles but not at the higher percentiles. For instance, refugee infants weigh 300 g less at the 10^{th} and 25^{th} percentile and 200 g less at the median; however, their weight is not different from that of natives at the 75^{th} and 90^{th} percentiles. Similarly, the native–refugee gap is 0.42 SD at the 10^{th} percentile, 0.40 SD at the 25^{th} percentile, but 0.28 SD at the median. No gap remains at the 75^{th} and 90^{th} percentiles.

The patterns of the gaps in the anthropometric variables are somewhat different. For WAZ, the gap is smaller but remains steady over the distribution. For HAZ, as for birthweight, the gap reduces at higher percentiles; however, unlike for birthweight, it persists at the higher percentiles. In terms of SD, the height gap is a substantial 0.74 at the 10^{th} percentile, 0.53 at the 25^{th} percentile, and 0.51 at the median, but it reduces to 0.38 at the 75^{th} percentile and 0.25 at the 90^{th} percentile.

These observed differences in birthweight and anthropometric outcomes could partially result from the socioeconomic differences between refugee and native households. Hence, in Table 2, we examine how the socioeconomic characteristics of the two groups compare. Regarding birth characteristics, an important difference is in the duration of pregnancy. Refugee women have, on average, a longer duration of pregnancy. In addition, due to higher fertility rates of refugee mothers, the birth order variable is on average higher for refugee children. For the same reason, the time gap with the preceding birth is more likely to be shorter for refugee children. Also, the mean age of refugee mothers at birth is about 3 years lower.

Regarding environmental characteristics, refugee children are more likely to be born in southern and eastern Turkey. They are also more likely to be born in province centers and less likely to be born in villages. Refugee mothers have lower levels of educational attainment. The incidence of smoking is higher for native than refugee mothers. A

Table 1. Summary statistics of birthweight and anthropometric measures

	Birth weight (in grams)		Birth weight (standardized)		Current weight (standardized)		Current height (standardized)		Current weight for height (standardized)	
	Natives	Refugees	Natives	Refugees	Natives	Refugees	Natives	Refugees	Natives	Refugees
(A) Basic descriptives										
Mean	3,140	2,953	0.110	−0.153	0.181	0.024	−0.249	−0.732	0.440	0.597
Standard deviation	639	779	0.897	1.094	1.072	1.171	1.221	1.518	1.166	1.257
10th percentile	2,300	2,000	−1.069	−1.491	−1.170	−1.320	−1.740	−2.480	−0.960	−0.930
25th percentile	2,800	2,500	−0.367	−0.789	−0.500	−0.670	−1.040	−1.570	−0.260	−0.080
Median	3,200	3,000	0.194	−0.087	0.170	0.040	−0.270	−0.780	0.430	0.590
75th percentile	3,500	3,500	0.616	0.616	0.820	0.720	0.520	0.140	1.140	1.340
90th percentile	3,900	3,900	1.177	1.177	1.510	1.360	1.230	0.980	1.850	2.060
(B) Probability of extreme outcomes										
Very low	0.119	0.192	–	–	0.015	0.038	0.060	0.169	0.017	0.022
Very high	0.052	0.040	–	–	0.046	0.040	0.034	0.044	0.081	0.109
Number of observations	2,638	1,331	2,638	1,331	2,174	1,376	2,102	1,363	2,090	1,411

Notes: The data come from the 2018 wave of Turkey Demographic and Health Survey. The sample includes babies born in the last five years preceding the survey. The refugee sample is restricted to children who were born in Turkey. Sampling weights at the mother level are used in tabulations. The standardized outcomes are in terms of *z*-scores. The extreme outcomes are defined as follows. The birth weight is classified as very low (high) if it is lower than 2,500 g (higher than 4,000 g). The current weight, height, and weight for height are classified as very low (high) if their standardized value is lower (higher) than two standard deviations of their average.

Table 2. Summary statistics of control variables

	Natives	Refugees		Natives	Refugees
Birth characteristics			Mother characteristics		
Baby sex			Mother education		
Boy	0.499	0.532	No education	0.100	0.115
Girl	0.501	0.468	Incomplete primary	0.048	0.053
Twin status			Complete primary	0.246	0.350
Single	0.970	0.972	Incomplete secondary	0.028	0.160
Twin	0.028	0.025	Complete secondary	0.188	0.140
Triplet	0.002	0.002	Incomplete high school	0.065	0.044
Duration of pregnancy			Complete high school or more	0.326	0.133
7 months or before	0.026	0.023	Mother smokes		
8 months	0.134	0.047	Never	0.800	0.929
9 months or more	0.840	0.923	Irregularly	0.058	0.037
Birth order			Regularly	0.140	0.034
1st birth	0.325	0.302			
2nd birth	0.319	0.243	Mother size		
3rd birth	0.206	0.174	Mother weight (mean in cm)	157.9	156.7
4th birth	0.081	0.111	Mother BMI (mean)	27.8	27.2
5th or later births	0.069	0.170			
Timing of the preceding birth			Household wealth		
Last 18 months	0.119	0.217	Household wealth		

Last 19–24 months	0.106	0.201	1st quintile	0.100	0.815
Last 25–30 months	0.088	0.145	2nd quintile	0.210	0.163
Last 31–36 months	0.093	0.134	3rd quintile	0.226	0.014
More than 36 months	0.583	0.298	4th quintile	0.235	0.007
Mother age at birth (mean)	27.59	24.37	5th quintile	0.229	0.000
Environmental characteristics			Household characteristics		
Birth region			Household members (mean)	5.300	7.332
West	0.409	0.193	Female household head	0.062	0.081
Central	0.132	0.072	Partner education		
South	0.140	0.357	No education	0.019	0.107
North	0.052	0.000	Incomplete primary	0.027	0.073
East	0.256	0.377	Complete primary	0.235	0.351
Type of birth region			Incomplete secondary	0.123	0.150
Province center	0.477	0.720	Complete secondary	0.380	0.230
District center	0.360	0.274	Complete high school or more	0.212	0.080
Sub-district or village	0.159	0.006			
Access to safe water	0.971	0.999	Number of observations	2,755	1,566
Access to safe sanitation	0.985	0.993			

Notes: The data come from the 2018 wave of Turkey Demographic and Health Survey. The sample includes babies born in the last 5 years preceding the survey. The refugee sample is restricted to children who were born in Turkey. Sampling weights at the mother level are used in tabulations.

remarkable difference exists in household wealth; 81.5% of refugees are in the lowest quintile. Regarding household characteristics, refugee households are bigger. They have on average 7.3 members compared to 5.3 for native households. Refugee households are also more likely to be headed by females. Summary statistics on health care and nutritional characteristics are provided in Data Appendix Tables A1 and A2.

4.2 Regression results

4.2.1 Main outcomes

Table 3 shows how the gaps in birthweight and anthropometric outcomes between native children and refugee children born in Turkey change as we gradually control for additional sets of covariates. As shown in panel (A), the baseline birthweight gap of 187 g drops to 164 g once we account for the differences between natives and refugees in birth characteristics. The gap decreases to 160 g as we further add mother characteristics and to 147 g once we also control for mother size. Adding household wealth makes the most significant reduction in the gap. This finding is not surprising as the household wealth of natives and refugees substantially differs, as shown in Table 2. After adding all sets of covariates, the baseline gap of 187 g reduces to 121 g. In terms of SD, the native–refugee gap falls from 0.263 to 0.171 once we control for all sets of covariates. In other words, the native–refugee differences in birth and socioeconomic characteristics explain about 35% of the birthweight gap. Nonetheless, although we account for a rich set of background characteristics, the native–refugee gap persists. This result suggests either that being a refugee has a direct effect on birthweight or that some unobserved measures affecting birthweight and differing significantly between natives and refugees are missing (or both). Given the rich set of covariates we use and the large remaining gap in birthweight in column (6), our findings strongly suggest a direct effect of being a refugee on birthweight. We also run an Oster (2019) test to assess the importance of potential selection on unobservables at the end of this subsection for all outcomes covered in this subsection.

Panel (C) of Table 3 shows that the baseline native–refugee gap in WAZ of 0.157 SD narrows to 0.085 once we account for birth characteristics and reduces further to 0.068 and loses its statistical significance when we also control for mother characteristics. The gap becomes 0.03 SD when we add the mother body size controls and is virtually zero when we control for all sets of covariates. In other words, we find no evidence of a direct impact of being a refugee on WAZ; the differences in the covariates explain all of the differences in the WAZ gap. In addition, in each column in Table 3, the native–refugee gap in WAZ is smaller than the gap in birthweight – suggesting a narrowing of the WAZ gap over time after birth.

By contrast, as shown in panel (D), the native–refugee HAZ gap remains even after controlling for all sets of covariates. This likely results from current height reflecting nutritional or health access during infancy that may not be readily measured by socioeconomic status at the time of the survey. Consistent with this fact, we observe that the baseline gap in HAZ (0.483 SD) is much higher than that in WAZ (0.157 SD). As column (3) shows, controlling for birth and mother characteristics and mother size explains one-third of the gap. Controlling for all sets of characteristics explains more than half of the baseline gap.

Finally, in Table 3, panel (E) illustrates the native–refugee gaps in WHZ. The baseline gap is 0.157 SD in favor of refugees – which results from the much larger

Table 3. Refugee–native differences in birthweight and anthropometric measures

	Baseline	Group 1 (baseline + birth char.)	Group 2 (group 1 + mother char.)	Group 3 (group 2 + mother size)	Group 4 (group 3 + environment char.)	Group 5 (group 4 + household char.)	Group 6 (group 5 + household wealth)
(A) Birth weight (in grams) (*N* = 3,969)							
Syrian refugee born in Turkey	−187.464***	−164.446***	−160.493***	−146.829***	−159.677***	−157.138***	−121.573***
	[29.578]	[30.309]	[30.863]	[30.686]	[32.973]	[34.772]	[45.656]
R^2	0.016	0.200	0.212	0.226	0.241	0.250	0.250
(B) Standardized birth weight (*N* = 3,969)							
Syrian refugee born in Turkey	−0.263***	−0.231***	−0.225***	−0.206***	−0.224***	−0.221***	−0.171***
	[0.042]	[0.043]	[0.043]	[0.043]	[0.046]	[0.049]	[0.064]
R^2	0.016	0.200	0.212	0.226	0.241	0.250	0.250
(C) Standardized current weight (*N* = 3,550)							
Syrian refugee born in Turkey	−0.157***	−0.085*	−0.068	−0.030	−0.023	−0.016	−0.002
	[0.044]	[0.048]	[0.050]	[0.049]	[0.056]	[0.059]	[0.077]
R^2	0.005	0.030	0.033	0.079	0.090	0.100	0.101
(D) Standardized current height (*N* = 3,465)							
Syrian refugee born in Turkey	−0.483***	−0.376***	−0.363***	−0.323***	−0.369***	−0.360***	−0.230**
	[0.056]	[0.061]	[0.063]	[0.061]	[0.072]	[0.079]	[0.101]
R^2	0.030	0.050	0.055	0.105	0.118	0.131	0.133
(E) Standardized current weight for height (*N* = 3,501)							
Syrian refugee born in Turkey	0.157***	0.183***	0.193***	0.216***	0.278***	0.295***	0.184**
	[0.049]	[0.053]	[0.056]	[0.056]	[0.064]	[0.068]	[0.089]
R^2	0.004	0.021	0.024	0.042	0.054	0.061	0.063

(*Continued*)

Table 3. (*Continued.*)

	Baseline	Group 1 (baseline + birth char.)	Group 2 (group 1 + mother char.)	Group 3 (group 2 + mother size)	Group 4 (group 3 + environment char.)	Group 5 (group 4 + household char.)	Group 6 (group 5 + household wealth)
Dummies for							
Gender, twin status, pregnancy duration, mother's age		Yes	Yes	Yes	Yes	Yes	Yes
Birth order and duration since the preceding birth		Yes	Yes	Yes	Yes	Yes	Yes
Mother education and smoking behavior			Yes	Yes	Yes	Yes	Yes
Mother's height and body mass index				Yes	Yes	Yes	Yes
Place of birth region, type of birth region					Yes	Yes	Yes
Safe water, safe sanitation					Yes	Yes	Yes
Household size, household head's sex, partner's education						Yes	Yes
Household wealth quintiles							Yes

Notes: The data come from the 2018 wave of Turkey Demographic and Health Survey. The sample includes babies born in the last 5 years preceding the survey. The refugee sample is restricted to children who were born in Turkey. Each cell shows the coefficient estimate of the Syrian refugee dummy for the specified outcome. The associated standard errors are displayed in parentheses. Each column displays results for a different group of control variables as specified at the bottom of the table. The standardized outcomes are in terms of *z*-scores. Sampling weights at the mother level are used. Standard errors are clustered at the mother level.
Statistical significance: *10% level, **5% level, ***1% level.

gap in HAZ than WAZ in favor of natives, discussed above. Once we account for the full set of covariates in the last column, the gap in WHZ rises to 0.184 SD in favor of refugees. Weight gain might be a concern among children transitioning from refugee to normal diets; in fact, Shapiro *et al.* (2016) report rapid weight gain after resettlement in the US for female children from Bhutan.

In Table 3, children's country of birth comes from the information directly provided in the dataset. In an alternative analysis, we construct it from women's birth and migration histories, both of which are available in year-month format. Appendix Table B1 shows that conducting the regression analysis based on the latter way provides quite similar results.

Next, we examine extreme outcomes of birthweight and children's anthropometric measures. Panel (A) of Table 4 shows that Syrian infants born in Turkey are 7.3 pp more likely to have low birthweight than native infants. This gap reduces to 4.8 pp when we adjust for the differences between natives and refugees in all sets of covariates. In contrast, panel (A) also shows that no native–refugee gap in high birthweight exists at the baseline or after accounting for the covariates. These results align with our findings in Table 1 that a gap exists in birthweight at the median and low percentiles but not at high percentiles.

Panel (B) of Table 4 shows that Syrian under-five children are 2.4 pp more likely to be underweight after accounting for the differences in the background covariates. However, no evidence exists of a difference in the probability of being overweight. Panel (C) indicates that refugee children are 10.9 pp more likely to be stunted at the baseline; however, this gap reduces to 6.0 pp after accounting for the covariates. However, we observe no evidence of a difference at the upper end of the distribution; refugee children are not less likely to be tall. We also do not find a difference in extreme values of WHZ between native and refugee babies after accounting for the covariates (panel D of Table 4).

To assess potential selection on unobservables, we carry out the Oster (2019) test. This test makes the proportional selection assumption, which means that the correlation between the treatment and the unobservables is proportional to the correlation between the treatment and observables – delta statistic.[6] Essentially, this delta statistic indicates how much more important unobservables have to be compared to observables for our coefficients to be completely driven by omitted variable bias. Estimating delta requires setting the value of a maximum of R^2 (R_{max}), which is the R^2 of a hypothetical regression of the outcome variable on treatment and observed and unobserved controls.

Oster (2019) suggests using 1.3 times the R^2 of the regression with controls for R_{max}. In fact, one of the applications Oster uses to illustrate her method is about birthweight. Therefore, we calculate R_{max} as 1.3 times the R^2 of a regression with a similar but expanded set of the controls she uses. Oster (2019) uses gestation week and women's race, age, education, income, and marital status in her analysis of birthweight. The set of controls we use include birth characteristics including gestation week (birth characteristics in Table 2), women's characteristics including age and education (mother characteristics in Table 2) but also women's physical characteristics (mother size characteristics in Table 2), and women's household characteristics (as in Table 2). Given the R_{max} calculated in this way, we find the value of delta that would produce a coefficient value of zero for our specification with full controls (group 6 in

[6]This method also makes the assumption that observables and unobservables are uncorrelated.

Table 4. Refugee–native differences in extreme birthweight and anthropometric outcomes

	Baseline	Group 6 (baseline + full set of controls from Table 3)	Baseline	Group 6 (baseline + full set of controls from Table 3)
(A) Birth weight ($N = 3{,}969$)	Low birth weight		High birth weight	
Syrian refugee born in Turkey	0.073***	0.048**	−0.012	−0.015
	[0.015]	[0.022]	[0.008]	[0.014]
R^2	0.010	0.216	0.001	0.051
(B) Current weight ($N = 3{,}550$)	Underweight		Overweight	
Syrian refugee born in Turkey	0.023***	0.024**	−0.006	0.016
	[0.006]	[0.012]	[0.008]	[0.015]
R^2	0.005	0.068	0.000	0.038
(C) Current height ($N = 3{,}465$)	Stunted		Tall	
Syrian refugee born in Turkey	0.109***	0.060***	0.010	0.017
	[0.012]	[0.022]	[0.007]	[0.014]
R^2	0.031	0.099	0.001	0.044
(D) Current weight for height ($N = 3{,}501$)	Wasted		Overweight	
Syrian refugee born in Turkey	0.005	−0.002	0.028**	0.027
	[0.005]	[0.014]	[0.012]	[0.021]
R^2	0.000	0.050	0.002	0.047

Notes: The data come from the 2018 wave of Turkey Demographic and Health Survey. Each cell shows the coefficient estimate of the Syrian refugee dummy from a linear probability model for the specified outcome. Low birth weight is defined as having birth weight lower than 2,500 g and high birth weight as the one larger than 4,000 g. The child is considered as underweight (overweight) if the standardized current weight is lower (higher) than two standard deviations of the average weight. The child is considered as stunted (tall) if the standardized current height is lower (higher) than two standard deviations of the average height. The child is considered as wasted (overweight) if the standardized current weight for height is lower (higher) than two standard deviations of the average weight for height. See notes to Table 3 for the sample restrictions and regression specification.
Statistical significance: *10% level, **5% level, ***1% level.

Tables 3 and 4). Appendix Table B2 shows that all estimated delta values are above one, as suggested in Oster (2019). Hence, selection on unobservables is unlikely to explain our findings in Tables 3 and 4.

4.2.2 Gaps over the distribution

The above analysis documents how the mean gap changes when we account for various sets of covariates. However, as shown in Table 1, the gaps in birthweight and anthropometric characteristics vary significantly over the distribution. For instance, a gap in birthweight does not exist at high percentiles (the 75th and 90th). Hence, here, we conduct a more nuanced analysis of the gaps by examining them over their respective distributions. We summarize this distribution using the hazard, which is most commonly applied in the analysis of duration data. The advantage of a hazard approach for examining distribution effects is that an increased hazard at low levels does not impose restrictions at higher levels. On the other hand, with a density or distribution function, early increases must be compensated with decreases at higher levels so that the density integrates to one.

Consider the case of birthweight in grams. In each case, the running variable is birthweight (as opposed to time in a duration-based analysis). We define intervals of birthweight: [0, 1,500), [1,500, 2,000), [2,000, 2,500), [2,500, 3,000), [3,000, 3,500), [3,500, 4,000), [4,000, .). The hazard rate at each interval is defined as having a birthweight within that interval conditional on having a birthweight higher than the maximum of the preceding time interval. For instance, a child that is 1,200 g fails in the first period (i.e., first interval in our case); a child that is 1,800 g survives the first period but fails in the second period, and so forth. A child that is more than 4,000 g is right-censored.

Figure 2 shows the results with and without the covariates used.[7] A native–refugee gap in hazard rates exists for birthweights less than 2,500 g. (Table 1 shows that 2,500 g correspond to the 25th percentile for refugees.) Moreover, the magnitude of the gap is larger when the birthweight is lower than 2,000 g. In this case, the odds of failure for refugees are about two times as much as that for natives. Similarly, when birthweight is defined in SD, we observe a gap for intervals below the mean. In this case, compared to the case with birthweight in grams, the gap persists for a more extended subset of the distribution, as the mean birthweight is about 3,000 g. It is also interesting to note that the hazard rate is lower for refugees at birthweights above 1 SD. As a result, we see similar levels for refugees and natives at the top of the distribution in Table 1, which cumulates the higher initial hazard rates with lower later hazard rates for refugees. For example, Table 1 shows that the 90th percentile of birthweight is equal for natives and refugees both in terms of grams and SD. The patterns are similar for HAZ and WAZ. For both variables, a gap in the hazard rates exists below 2 SD in Fig. 2. Moreover, the gap below 3 SD is larger for both variables.[8]

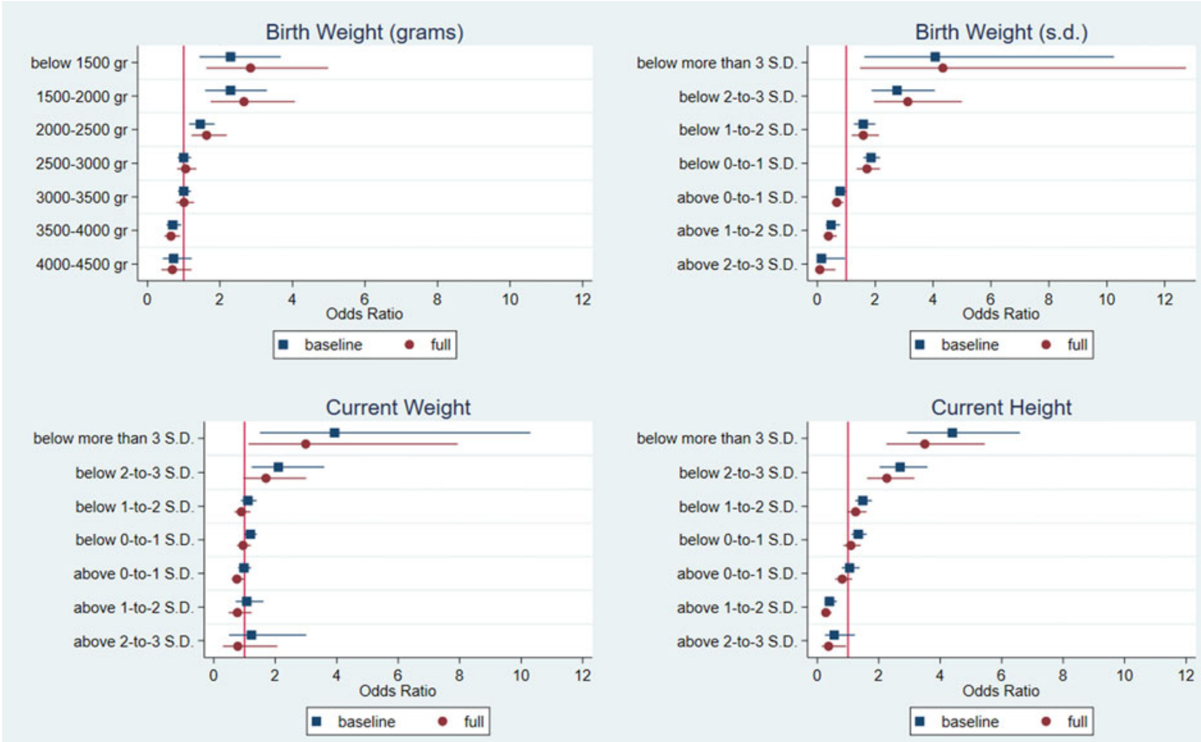
4.2.3 Health inputs

Table 5 shows the baseline native–refugee gaps in prenatal care, postnatal care, vaccination, and nutrition outcomes and how these gaps change as we account for the differences in their background characteristics. Panel (A) shows that, once we account for the covariates, no native–refugee gap remains in receiving prenatal care, but the gap in receiving prenatal care at least four times persists.

Conditional on receiving prenatal care, no difference exists in taking it from a health specialist. We observe a large gap, 14 pp, in receiving prenatal care early (in the first trimester) at the baseline; however, this gap disappears after accounting for the covariates. We also see large gaps, even after controlling for covariates, in receiving

[7]In the rest of the study, our analysis focuses on the outcomes where we observe some deficits for refugee infants. Thus, the results for weight for height are delegated to the Appendix.

[8]The results for WHZ are given in Appendix Fig. A1. The hazard rates indicate no higher probability of exit at lower values of WHZ, suggesting that refugees are not more likely to be wasted. In contrast, the hazard rates for refugees are lower at higher values of WHZ, suggesting an elevated likelihood of being overweight for refugees at the top of the distribution.



Notes: The data come from the 2018 wave of the Turkey Demographic and Health Survey. The sample includes babies born in the last five years preceding the survey. The refugee sample is restricted to children who were born in Turkey. Each dot shows the odds ratio of the Syrian refugee dummy for the specified outcome. The associated bars display 95 percent confidence intervals. The vertical line displays the odds ratio at 1. The full model includes the list of all control variables displayed in Table 3. Sampling weights at the mother level are used.

Figure 2. Distributional analysis of birthweight and anthropometric measures.

Table 5. Refugee–native differences in health care, vaccination, and nutrition

	Baseline	Group 6 (baseline + full set of controls from Table 3)
Panel (A) Prenatal care (N = 3,222)		
Prenatal care taken	−0.0233***	0.0204
Visited at least four times	−0.2524***	−0.1015***
Iron tablets received	0.0164	0.0841***
Conditional on prenatal care taken		
Given by a health specialist	0.0005	0.0024
Given in a health facility	−0.0052**	−0.0011
First visit in the first trimester	−0.1416***	−0.0159
First visit in the second trimester	0.1090***	0.0158
First visit in the third trimester	0.0326***	0.0001
Mother weighted	−0.3586***	−0.2684***
Blood pressure measured	−0.2598***	−0.2114***
Urine sample given	−0.2267***	−0.1530***
Blood sample given	−0.2246***	−0.1307***
Ultrasound test received	−0.0272***	−0.0151
Abdominal test received	−0.3004***	−0.1472***
Tetanous injection received	−0.5079***	−0.4139***
Panel (B) Postnatal care (N = 3,214)		
Postnatal care taken	−0.1219***	−0.0730***
Conditional on care taken		
Given by a health specialist	0.0011	0.0059*
Given in a health facility	−0.0013	−0.0004
Given in the first month after delivery	0.0112	0.0197
Panel (C) Vaccination (N = 1,762)		
Fully vaccinated, 12–35 months	−0.1050***	0.0507
Panel (D) Breastfeeding (N = 3,222)		
Never breastfed	0.0359***	0.0184
Breastfed within an hour after delivery	0.0008	0.0241
Breastfed at least 6 months, 7–60 months	−0.0645***	−0.0540*
Panel (E) Nutritional take-in		
For infants aged 1–6 months (N = 499)		
Breast milk	−0.0197	0.0181
Baby formula	−0.1668***	−0.1444**

(*Continued*)

Table 5. (*Continued.*)

	Baseline	Group 6 (baseline + full set of controls from Table 3)
Milk product	0.0445	−0.0059
Protein	−0.0456***	−0.0579*
For infants aged 7–36 months (*N* = 2,185)		
Breast milk	−0.0576**	−0.0561
Baby formula	−0.0212	−0.0201
Milk product	−0.0671***	0.0330
Protein	−0.3101***	−0.1236***
For infants aged 7–18 months (*N* = 899)		
Breast milk	−0.0829**	−0.0563

Notes: The data come from the 2018 wave of Turkey Demographic and Health Survey. The samples in panels (A), (B), and (D) include the youngest child born in the previous 5 years for each mother. The samples in panels (C) and (E) include children born in the previous 3 years for each mother. In panel (D), breastfeeding for at least 6 months is analyzed for the sample of infants who are 7 months or older. In panel (E), the analysis is conducted separately for 1–6-month-old and 7–36-month-old babies. The refugee sample is restricted to children who were born in Turkey. For some outcomes, the number of observations is smaller than the reported one because of additional conditioning and missing values. Each cell shows the coefficient estimate of the Syrian refugee dummy for the specified outcome. Each column displays results for a different group of control variables. See notes to Table 3 for the list of control variables in each group and for other details of regression specification.
Statistical significance: *10% level, **5% level, ***1% level.

several types of health checks, such as mother weighing, blood pressure, collection of urine or blood samples, and receiving an abdominal test or tetanus injection. We attribute this to the fact that these tests are more likely to be given in private health care centers, which are used more frequently by natives. On the other hand, the small baseline gap in receiving an ultrasound test – which is conducted at all types of health care facilities – vanishes after accounting for the covariates.

Panel (B) of Table 5 shows postnatal care outcomes. Even after accounting for the differences in covariates, refugees are 7.3 pp less likely to receive postnatal care. However, conditional on receipt of postnatal care, not much difference exists in the type of postnatal care received. Although there is weak evidence of a gap in receiving postnatal care by type of practitioner, its magnitude is trivial. Panel (C) provides the results about vaccination. At the baseline, refugee children are 10.5 pp less likely to be fully vaccinated. However, after accounting for the covariates, no evidence of a gap in full vaccination remains.

Panel (D) presents the estimates for breastfeeding outcomes. Even after accounting for the covariates, refugee children are 5.4 pp less likely to be breastfed for at least 6 months than native children.[9] However, they are not less likely to be never breastfed or breastfed within an hour of delivery. In other words, refugee babies seem to lag behind not in the incidence but in the duration of breastfeeding.

[9]We use a sample of children who are 7 months or older for the outcome about breastfeeding for at least 6 months.

Panel (E) shows the native–refugee gaps in certain nutritional take-ins for 1–6-month-old and 7–36-month-old babies separately. For 1–6-month-old babies, the WHO recommends exclusive breastfeeding for at least 4 months (if possible 6). In fact, we find no native–refugee gap in breastfeeding. However, refugees are less likely to consume baby formula and protein. The WHO advises the use of formula only if breast milk is insufficient during the first 6 months. Therefore, if breastfeeding rates of both groups are adequate, the additional formula used by natives is unnecessary. Conversely, if breastfeeding rates are insufficient, the lower intake of formula by refugee children indicates that they may not be receiving adequate nutrition.

For 7–36-month-old babies, we find refugees are less likely to be currently breastfed in the baseline. Although the statistical significance disappears after including the covariates, the coefficient magnitude does not change much from that in the baseline specification. We also examine the difference in breastfeeding status between native and refugee babies aged 7–18 months, as mothers may stop breastfeeding older infants following a subsequent birth. The findings in the final row of panel (E) for this age group closely mirror those for babies aged 7–36 months.

The WHO recommends introducing solid foods to babies after they are 6 months old. However, we find that 7–36-month-old refugee babies are less likely to consume protein. Additionally, for 7–60-month-old babies (from panel D of Table 5), we know that refugees are less likely to be breastfed for at least 6 months. These two critical findings are evidence of nutritional deficiencies in refugee children. Our findings about anthropometric outcomes are also consistent with this conclusion.

To assess whether differences in health care utilization help explain variation in anthropometric outcomes, we introduce health behaviors as predictors. Results, of course, need to be interpreted with caution as these are outcomes that may in fact be influenced by perceptions of the risk of poor nutritional outcomes. Table 6, which includes the youngest child born to each mother, shows that the native–refugee gap in birthweight decreases from 102 to 78 g (by 31%) and becomes statistically insignificant at the conventional levels when we include the covariates for prenatal care. However, the magnitude of the remaining difference is certainly not small. This finding is impressive because we already account for a rich set of covariates, pointing to the importance of prenatal care in birthweight. Panel (D) shows that adding prenatal controls to the specification reduces the gap in HAZ from 0.253 to 0.224 (by about 11%). In contrast, controlling for postnatal care and breastfeeding does not reduce the gap,[10] although native–refuge gaps exist in certain postnatal care and breastfeeding characteristics. This suggests that either postnatal care and breastfeeding characteristics do not matter much for age-adjusted height or that variation in such measures is already captured by the socioeconomic measures.

Similarly, Table 7, which includes all children born within the last 3 years of the survey date, examines how the native–refugee gaps in WAZ and HAZ change with the inclusion of vaccination and nutrition controls. Panel (A) on WAZ provides no findings worthy of note, as no gap exists before the inclusion of vaccination and nutrition controls. Panel (B) shows that including the vaccination controls does not

[10]We first define the status of breastfeeding by age as a categorical variable and then use dummies for each state as control variables in the regression. The mutually exclusive categories are: (i) never breastfed, (ii) 1–6-month-old and stopped breastfeeding, (iii) 1–6-month-old and currently breastfeeding, (iv) 7–60-month-old and stopped breastfeeding, (v) 7–60-month-old and currently breastfeeding.

Table 6. Refugee–native gaps in birthweight and anthropometric measures, controlling for health care and breastfeeding characteristics

	Baseline	Group 6 (baseline + full set of controls from Table 3)	Group 7 (group 6 + prenatal health care char.)	Group 8 (group 6 + postnatal health care char.)	Group 9 (group 6 + breastfeeding char.)
(A) Birth weight (in grams) ($N = 3{,}007$)					
Syrian refugee born in Turkey	−203.603***	−102.173**	−78.288	–	–
	[30.140]	[49.608]	[51.363]		
R^2	0.019	0.242	0.255	–	–
(B) Standardized birth weight ($N = 3{,}007$)					
Syrian refugee born in Turkey	−0.286***	−0.143**	−0.110	–	–
	[0.042]	[0.070]	[0.072]		
R^2	0.019	0.242	0.255	–	–
(C) Standardized current weight ($N = 2{,}675$)					
Syrian refugee born in Turkey	−0.147***	0.013	0.028	0.006	−0.014
	[0.051]	[0.085]	[0.091]	[0.086]	[0.085]
R^2	0.004	0.120	0.125	0.124	0.132
(D) Standardized current height ($N = 2{,}604$)					
Syrian refugee born in Turkey	−0.434***	−0.253**	−0.224**	−0.262**	−0.308***
	[0.064]	[0.102]	[0.110]	[0.103]	[0.102]
R^2	0.023	0.137	0.150	0.140	0.178
Dummies for					

Full set of controls from Table 3	Yes	Yes	Yes	Yes
Number of prenatal visits, timing of first prenatal visit		Yes		
Place and person giving prenatal care		Yes		
Iron tablets, several types of prenatal care tests		Yes		
Timing of postnatal care			Yes	
Place and person giving postnatal care			Yes	
Timing of starting breastfeeding				Yes
Duration of breastfeeding				Yes

Notes: The data come from the 2018 wave of Turkey Demographic and Health Survey. The sample is restricted to the youngest child born in the previous 5 years for each mother due to data availability. The refugee sample is restricted to children who were born in Turkey. Each cell shows the coefficient estimate of the Syrian refugee dummy for the stated outcome and regression specification. The standardized outcomes are in terms of *z*-scores. See notes to Table 3 for other details of regression specification.
Statistical significance: *10% level, **5% level, ***1% level.

Table 7. Refugee–native gaps in anthropometric measures controlling for vaccination and nutritional characteristics

	Baseline	Group 6 (baseline + full set of controls from Table 3)	Group 10 (group 6 + vaccination char.)	Group 11 (group 6 + nutritional char.)
(A) Standardized current weight (*N* = 2,443)				
Syrian refugee born in Turkey	−0.134**	0.003	−0.007	−0.005
	[0.055]	[0.094]	[0.094]	[0.094]
R^2	0.003	0.130	0.134	0.135
(B) Standardized current height (*N* = 2,175)				
Syrian refugee born in Turkey	−0.514***	−0.254**	−0.265**	−0.234*
	[0.070]	[0.122]	[0.122]	[0.121]
R^2	0.031	0.152	0.222	0.208
Dummies for				
Full set of controls from Table 3		Yes	Yes	Yes
Fully vaccinated			Yes	
Taking protein, milk, baby formula				Yes

Notes: The data come from the 2018 wave of Turkey Demographic and Health Survey. The sample is restricted to children born in the previous 3 years due to data availability. The refugee sample is restricted to children who were born in Turkey. Each cell shows the coefficient estimate of the Syrian refugee dummy for the stated outcome and regression specification. The standardized outcomes are in terms of *z*-scores. See notes to Table 3 for other details of regression specification.
Statistical significance: *10% level, **5% level, ***1% level.

significantly affect the age-adjusted height. However, including nutrition controls reduces the HAZ from 0.265 to 0.234 (by 12%).[11]

We replicate Fig. 2 (our analysis of gaps over the distribution) including the health care and breastfeeding characteristics in Appendix Fig. A2 and the nutritional and vaccination characteristics in Appendix Fig. A3. We are primarily interested in whether these additional controls can account for the large gaps at the bottom of the distributions of birthweight and anthropometric measures, shown in Fig. 2, more than they can account for the gaps at the mean. However, Appendix Figs A2 and A3 show that the gaps at the bottom of the distributions persist.

[11]Appendix Table B3 shows how native–refugee gaps in WHZ change with the inclusion of (i) health care and breastfeeding controls and (ii) vaccination and nutrition controls. The gap in favor of refugees persists, and quantitatively the gap is similar.

4.2.4 Refugee children born in Turkey vs. born in Syria

Our analysis so far included only refugee children born in Turkey because environmental and household characteristics and household wealth conditions that a child was born into when the family was in Syria are not observed. However, comparing births in Syria and births in Turkey among refugees can be informative about how much time spent in a conflict zone during pregnancy and afterward matters in children's birthweight and anthropometric measures. We thus include refugee children born in Syria as a separate group and compare both the refugee children born in Turkey and the refugee children born in Syria with native children. Our analysis here adjusts for covariates on birth and mother characteristics and mother size (which are also available for children born in Syria).

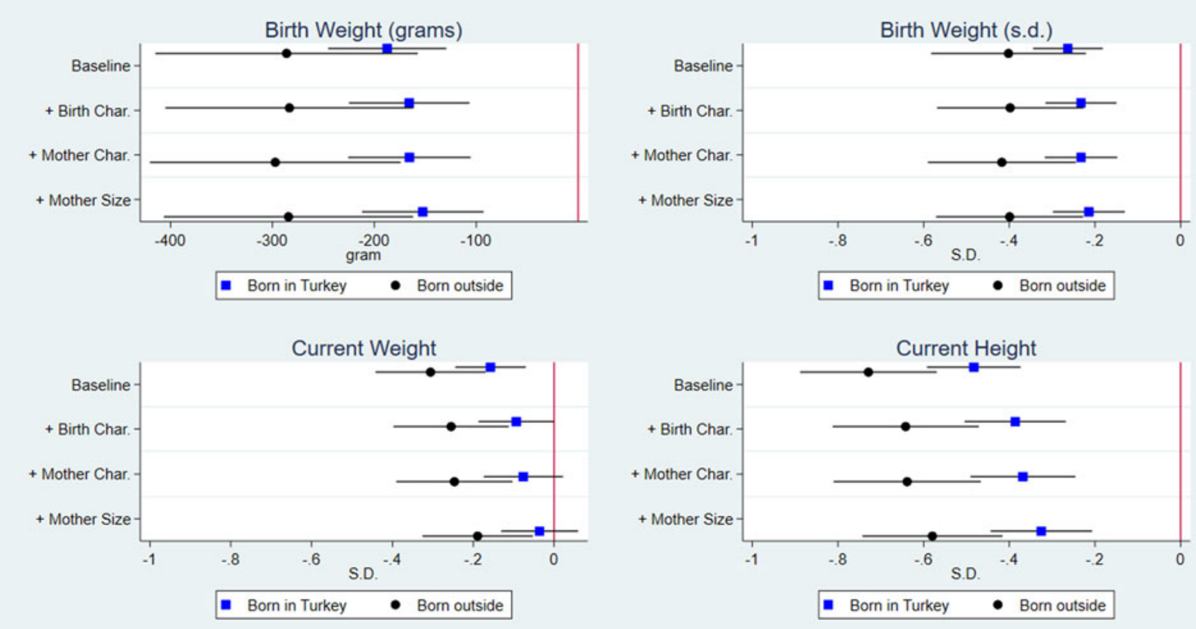
Figure 3 displays that the birthweight gap for refugee children born outside Turkey is larger than the gap for refugee children born in Turkey. The gap for refugee children born outside Turkey is about 0.4 SD at the baseline and does not change much with the addition of covariates. In contrast, the gap for refugee children born in Turkey is about 0.26 SD at the baseline and reduces to 0.21 SD with the addition of covariates.

The patterns are similar for WAZ and HAZ. While the baseline gap in WAZ is 0.157 for refugee children born in Turkey, it is 0.306 for refugee children born outside Turkey. The gap for refugee children born in Turkey reduces from 0.157 to 0.036 and becomes statistically insignificant with the addition of covariates. In contrast, the gap for refugee children born outside Turkey persists even after accounting for covariates, although it reduces from 0.306 to 0.189. The baseline gap in HAZ is 0.483 for refugee children born in Turkey but 0.729 for those born outside Turkey. The difference in gaps persists even after accounting for covariates; it reduces to 0.325 for the former group and 0.580 for the latter.

Next, we examine the differences between refugee children born in Turkey and outside Turkey based on the estimates in Fig. 3. Part (b) of the notes to Fig. 3 provides the p-values regarding the difference between the coefficient estimates for refugee children born in Turkey and outside Turkey (where the baseline is native children). Statistically significant difference exists for birthweight, WAZ, and HAZ between the two groups of refugee children, in favor of those born in Turkey.

As a robustness check, we also carry out a sibling fixed-effects estimation using only the refugee sample – directly comparing siblings born in Turkey and in Syria. The results in Appendix Table B4 show that refugees born outside Turkey have lower birthweight, both in grams and in standardized values, than refugees born in Turkey (as in Fig. 3). The differences are large in absolute magnitude, albeit smaller than those in Fig. 3. Moreover, they are not statistically significant at the conventional levels – which results not only from the lower magnitude of the coefficients but also from higher standard errors. Appendix Table B4 also displays large differences between refugee children born in Turkey and outside Turkey in terms of HAZ and WAZ, in favor of those born in Turkey. The gap in WAZ persists even after accounting for the covariates, as in Fig. 3. The difference in HAZ remains large after controlling for the covariates, as in Fig. 3, but it loses its statistical significance.

In essence, the sibling fixed-effects estimation results mostly support our main findings in Fig. 3. The differences for all three outcomes are similarly in favor of refugees born in Turkey. While statistical evidence exists for a difference in WAZ, the gaps for birthweight and HAZ have lower precision in the sibling fixed-effects estimation. This is presumably expected because fixed-effects estimates are typically smaller as differencing aggravates the measurement error problem. In addition, the



Notes: a) The data come from the 2018 wave of the Turkey Demographic and Health Survey. The sample includes babies born in the last five years preceding the survey. The numbers of observations are 4224, 3881, and 3796 for the analyses of birthweight, current weight, and current height, respectively. Each dot shows the coefficient estimate of the Syrian refugee dummies for the specified outcome and regression specification. The associated bars display the 95 percent confidence intervals. Sampling weights at the mother level are used. Standard errors are clustered at the mother level. The vertical line displays point 0. See Table 3 for the list of control variables in each group.

b) The p-values for the difference between the point estimates of birthweight for refugees born in and outside Turkey are 0.145, 0.063, 0.037, and 0.036, respectively. The p-values for the difference between the point estimates of current weight for refugees born in and outside Turkey are 0.037, 0.023, 0.015, and 0.024, respectively. Finally, the p-values for the difference between the point estimates of current height for refugees born in and outside Turkey are 0.004, 0.003, 0.002, and 0.002, respectively.

Figure 3. Refugee–native gaps in birthweight and anthropometric measures by refugees' birth country.

variation in sibling fixed-effects estimation comes from mothers with births before and after arrival in Turkey; hence, it is more likely to include women with a higher propensity to give birth.

4.2.5 Refugee children born in Turkey by country of conception and trimester

The literature points to the detrimental causal effects of stress exposure during pregnancy – particularly in the first trimester (see, e.g., Camacho, 2008; Guantai & Kijima, 2020; Mansour & Rees, 2012; Torche, 2011; Tsujimoto & Kijima, 2020). The identification strategy in these studies typically exploits the exogenous variation in stress exposure across regions due to the differences in the intensity of conflicts or natural events such as earthquakes.[12] Brown (2018) examines the impact of exposure to violent crime in utero on birth weight in Mexico. Unlike the above studies that use regional variation in stress exposure, violent crime (local homicide rates) could also affect fertility and migration in this context; hence, Brown (2018) checks for selective fertility and migration.

In this section, we examine how native–refugee gaps in birthweight and anthropometric measures of refugee children vary by exposure to war during pregnancy – by comparing refugee children born in Turkey according to the country in which they spent their first trimester. Our setting is similar to Brown's (2018) in that refugees' arrival in Turkey could change their fertility patterns. Hence, we first check whether the fertility rates of Syrian refugee women are different before and after their arrival in Turkey. For this purpose, we restrict the Syrian sample of the 2018 TDHS to women who have ever cohabited. We put these women's birth history data into a woman-age structure, in which each period is one age. The event history starts at the age of first cohabitation for each woman and continues until the age of the survey year. The dependent variable, the birth dummy, takes the value of one if the woman gives birth at that age and zero otherwise. We define a civil war dummy that takes the value of one for years after 2011 and a Turkey dummy variable that takes the value of one for years after the year of arrival in Turkey. As control variables, we include women's age dummies and dummies for women's mother tongue, province of birth in Syria, birthplace type in Syria, and women's educational attainment. The results in Appendix Table B5 show that the probability of a woman giving birth declines by about 1.7 percentage points (from a baseline level of 28.4%) after the onset of the civil war. However, no statistical evidence exists that arrival in Turkey changes the birth propensity after the onset of the civil war. Therefore, we do not face a compositional selection when we compare the births before and after arrival in Turkey.

In the main analysis of this section, we take the sample of native children and refugee children born in Turkey and separate refugee children into two groups in two different ways: whether they spent the first trimester in Syria and whether they spent any time during pregnancy in Syria. We focus on narrow periods around the exact timing of arrival.[13] Table 8 gives the results by the country of the first trimester in panel (A)

[12]A related literature focuses on the effects of conflict children face in their early years on their later outcomes. This literature reports adverse effects on HAZ (Akresh *et al.* [2012] in the context of Eritrea–Ethiopia war and Bundervoet *et al.* [2009] in the context of the civil war in rural Burundi), elevated incidence of chronic health conditions during adulthood (Akbulut-Yüksel, 2017), and worse child health (Minoiu & Shemyakina, 2014).

[13]Even though refugees may realize better conditions in the host country over time, their initial months in the host country might still be stressful. However, they would not face food shortages and unsanitary conditions after arrival.

Table 8. Refugee–native gaps in birthweight and anthropometric measures by country of first trimester and country of conception

	Standardized birth weight		Standardized current weight		Standardized current height	
	Baseline	Full	Baseline	Full	Baseline	Full
Panel (A) Trimester country						
Syrian refugee spent trimester in Syria (a)	−0.383**	−0.231	−0.637***	−0.481***	−0.789***	−0.534***
	[0.153]	[0.162]	[0.117]	[0.133]	[0.175]	[0.194]
Syrian refugee spent trimester in Turkey (b)	−0.261***	−0.160**	−0.126***	0.033	−0.458***	−0.202**
	[0.042]	[0.064]	[0.046]	[0.077]	[0.057]	[0.103]
Difference (b–a)						
Estimate	0.122	0.071	0.511***	0.514***	0.332*	0.332*
SE	[0.155]	[0.154]	[0.119]	[0.117]	[0.178]	[0.178]
Number of observations	3,940	3,940	3,518	3,518	3,432	3,432
Panel (B) Conception Country						
Syrian refugee conceived in Syria (a)	−0.229**	−0.142	−0.583***	−0.432***	−0.862***	−0.624***
	[0.111]	[0.119]	[0.093]	[0.118]	[0.133]	[0.163]
Syrian refugee conceived in Turkey (b)	−0.275***	−0.166***	−0.112**	0.049	−0.436***	−0.185*
	[0.043]	[0.064]	[0.047]	[0.078]	[0.059]	[0.103]
Difference (b–a)						
Estimate	−0.046	−0.024	0.471***	0.481***	0.427***	0.439***
SE	[0.114]	[0.107]	[0.096]	[0.096]	[0.137]	[0.139]
Number of observations	3,914	3,914	3,495	3,495	3,409	3,409

Notes: The data come from the 2018 wave of Turkey Demographic and Health Survey. The sample includes babies born in the last 5 years preceding the survey. The refugee sample is restricted to children who were born in Turkey. In each panel, the refugee sample is further restricted and divided into two groups as defined in the title of the panel. Each cell shows the coefficient estimate of the specified Syrian refugee dummy for the specified outcome. The associated standard errors are displayed in parentheses. The standardized outcomes are in terms of *z*-scores. See notes to Table 3 for details of regression specification.
Statistical significance: *10% level, **5% level, ***1% level.

and the country of conception in panel (B). In both panels, both refugee groups have lower birthweight and HAZ than natives. In contrast, only refugees who were conceived in Syria or spent the first trimester in Syria have lower WAZ than natives after accounting for the covariates. The results in the previous subsection about the differences between refugee children born in Turkey and those born in Syria could result from institutional differences between Syria and Turkey. As we analyze only infants born in Turkey in Table 8, the results suggest that the experience of a civil war and refugee status rather than the differences between the two countries may be a significant predictor of child growth.

Next, we discuss our core findings of this subsection regarding whether or not native–refugee gaps in birthweight and anthropometric measures of refugee children vary by exposure to war during pregnancy. As can be seen in Table 8, when we compare the two refugee groups to see if birthweight and anthropometric outcomes are associated with time spent in the conflict zone, we observe that refugee children who spent their first trimester in Syria or were conceived in Syria have much lower HAZ and WAZ. Quantitatively, Table 8 indicates that WAZ and HAZ are 0.48 and 0.44 lower for the refugee children conceived in Syria than the refugee children conceived in Turkey. In contrast, no evidence of a difference in birthweight exists. We check the robustness of these findings by placing upper limits on the time in Turkey since conception so that we can compare women who arrived in Turkey after conception and women who conceived relatively soon after arriving in Turkey. The estimates in Appendix Table B6 show that the results are robust. In essence, these results indicate that exposure to war during pregnancy has adverse effects on anthropometric outcomes. This finding is similar to the findings of the studies estimating the causal effects of stress exposure during pregnancy, discussed at the beginning of this subsection. In our setting, the population of interest is different in the way that we examine it for a group of refugees.

Finally, we revisit Fig. 2 to see if the large gaps observed at the bottom of the birthweight and anthropometric measure distributions stem from a higher probability of this part of the distributions, including refugee children conceived in Syria. For this purpose, we replicate Fig. 2 by excluding the children who spent their first trimester in Syria in Appendix Fig. A4 and the children conceived in Syria in Appendix Fig. A5. The results show that excluding these children changes the results very little.

4.2.6 Heterogeneity by years in Turkey

A potentially important variable in refugee children's growth outcomes is the duration of residence of their mothers in Turkey at the time of birth and at the time of the measurement of the anthropometric outcomes (which is the survey date). A longer time in Turkey not only allows women to overcome any traumatic effects of the war and forced migration but gives them time to become more familiar with the health care system in Turkey. Therefore, in an alternative specification, we interact the refugee status with the mother's residence duration at the time of each birth in estimating the native–refugee differences in birthweight and with that at the time of measurement for anthropometric outcomes. Since birthweight measurements are for the year children are born, they exhibit calendar year variation, unlike current weight and height measurements. Hence, we estimate a further specification – only for birthweight – where we use year-of-arrival dummies in addition to the duration of residence. The results, given in Appendix Table B7, indicate no evidence of a significant variation in the native–refugee gaps by the duration of residence in Turkey.

4.3 Robustness checks

4.3.1 Missing data

Our dependent variables are missing for some observations. Birthweight is missing for 4.2% of native and 15.0% of refugee children, and HAZ (WAZ) is missing for 23.7% (21.1%) of native and 13.0% (12.1%) of refugee children. However, for all observations, qualitative information on the baby's size at birth (very large, large, average, small, very small) is available. Hence, using the quantitative measurements for each dependent variable that is non-missing, we generate the means for each qualitative size. Then, for observations for which quantitative measurements are missing, we assign the mean based on the qualitative size. We repeat our primary analysis (given in Table 3) using this sample of observations with imputed data. The results in Appendix Table B8 show that the patterns of the estimates and the estimated gaps are highly similar.

We also conduct the same analysis with the sample of infants who have the full set of birthweight and anthropometric outcomes. With this analysis, we aim to check whether the ordering of the estimated gaps in the outcomes of interest results from the compositional changes in the analyzed samples resulting from missing data. However, the results (given in Appendix Table B9) are similar to our primary analysis. Quantitatively, controlling after the full set of covariates, the largest gap is observed for HAZ (0.254), while the gap in birthweights is relatively smaller (0.206 SD), and this gap in weights closes over time.

4.3.2 Potential sample selection via infant mortality

A difference in mortality rates between native and refugee children would cause a sample selection bias in our estimates for birthweight and anthropometric outcomes. Therefore, we examine the infant mortality gaps between the two groups. Appendix Table B10 shows no difference in infant mortality rates either at the baseline or after controlling for the covariates. Although infant mortality is a rare event and our sample size is not very large, the lack of evidence of a gap is not only due to a lack of precision; the magnitude of the gap is also small at the baseline.[14] Thus, differential mortality selection is not likely to be an important factor in comparisons of refugee and native health in our context.

Finding no gap in mortality leads to another concern about our results. If the likelihood of survival is more than the expected level for "weaker" refugee infants at birth in our sample, then we would see no gap in mortality, and large gaps detected in birthweight and HAZ between natives and refugees might result from this sort of selection. To address this concern, we repeat our primary analysis by excluding infants whose birth size is "very small" based on the qualitative measure (i.e., a proxy for "weaker" children). The results in Appendix Table B11 show similar

[14]The refugee–native gap coefficients become negative after accounting for the covariates, and their size also gets larger. Infant mortality is a quite rare event in Turkey. For instance, in every 10,000 births, about 18 babies died by the end of the first year in our sample. In such a setup, the existence of a few outliers, in terms of controls, would affect the estimated size considerably. Thus, we prefer not to attach any meaning to the magnitude of the coefficients in the specification with control variables, especially when they are not statistically significant.

patterns of the gaps in birthweight and anthropometric outcomes. This suggests that our results are not driven by the survival of weaker infants.

4.3.3 Potential self-selection in migration

The worse outcomes in birthweight and anthropometric measures among refugees could partly result from a negative selection in terms of health outcomes in the migration decision to Turkey. In our forced migration context, we would expect selection to be less likely. In fact, Ferris and Kirişci (2016) report that most refugees stated that they left Syria for security reasons and chose Turkey as their destination due to the ease of transportation. Nonetheless, we check for potential selection in educational outcomes by comparing the educational attainment of adults in the 2009 SFHS and the 2018 THDS. We would expect any health selection to be correlated with the educational selection. As a 9-year gap exists between the datasets, we compare the same birth cohorts in the two datasets. In addition, since most Syrian refugees in Turkey originate from the northern provinces, we weight the Syrian provincial averages in the 2009 SFHS by the distribution of province of birth of Syrian refugees in Turkey. Appendix Table B12 shows that the educational distributions in the two countries are quite similar.

4.3.4 Alternative sample restrictions

The Syrian sample of the 2018 TDHS includes no observations living in villages or in northern Turkey. In fact, few Syrians live in these areas (TPMM, 2022). Therefore, we define alternative samples by excluding natives (i) who live in northern Turkey, (ii) who live in villages, and (iii) who live in northern Turkey or in a village. We provide the results in Appendix Tables B13–B15. The qualitative patterns are the same, and the coefficient magnitudes are also similar to those in Table 3.[15]

5. Conclusion

Refugee infants born in Turkey have lower birthweight and age-adjusted weight and height than native infants. When we account for a rich set of birth and socioeconomic characteristics that display substantial differences between natives and refugees, the native–refugee gaps in birthweight and age-adjusted height persist, but the gap in age-adjusted weight disappears. In other words, refugee infants, on average, close the weight gap over time. The rich set of covariates we use explains about 35% of the baseline difference in birthweight and more than half of the baseline difference in HAZ. However, even after that, refugee infants' average birthweight is 0.17 SD lower and their HAZ is 0.23 SD lower. These gaps are even larger for refugee infants born outside Turkey.

The differences between refugees born in Turkey and natives in birthweight and anthropometric outcomes are limited to the lower end of the distribution. In addition, the gap gradually widens as we move toward the lower end of the distribution for each outcome. No native–refugee gap exists above the mean level for any of the outcomes. After accounting for the covariates, refugee infants born in Turkey are 4.8 pp more likely to have low birthweight but not less likely to have high birthweight. Similarly, refugee infants are 2.4 pp more likely to be underweight

[15] The results in Table 3 control for the region of residence and the type of location of residence (urban, rural).

and 6.0 pp more likely to be stunted; however, they are not less likely to be overweight or tall.

Certain differences in prenatal care (such as the frequency of checks and type of checks) persist between native and refugee mothers, and these differences in prenatal care explain a further 30% of the remaining variation in birthweight. The differences in prenatal care behavior also explain part of the HAZ gap. Although refugees are less likely to take postnatal care, this does not seem to be important for the gaps in anthropometric outcomes. We find no differences in vaccination behavior between natives and refugees after accounting for the covariates. Important differences in breastfeeding and nutrition behavior also exist between the two groups, and these differences explain part of the remaining gap in HAZ.

Overall, the results suggest that, at least conditional on household economic resources, Syrian refugee children are well-served by the Turkish public health system, broadly construed. Refugees are differentially represented among households with low economic resources, but that points more toward a need for continued expansion of economic opportunities than a need for targeted health and nutritional programs per se. At the same time, our results point, in particular, to the deficits at the lower end of the distribution. On top of the existing universal health insurance, there might be a need for additional programs targeting refugees at high risk for low birth weight or other early-child deficits. Furthermore, our findings suggest that the physical deficiencies seen in refugee children under the age of five may be linked to the stress their mothers experienced during pregnancy in Syria, particularly in the first trimester, rather than solely due to their refugee status.

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