

Medium-term height growth benefits of staple food subsidies: a quasi-experimental analysis of the Indonesia Family Life Survey

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Research Article

Keywords: Food subsidies, staple food, height growth, food access, health disparities

Posted Date: September 10th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-10603341/v1>

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Additional Declarations: No competing interests reported.

Abstract

Background

Despite progress, stunting remains common in Southeast Asia. Social protection may influence child growth through improving food access. Staple food subsidies are implemented in many countries, including Indonesia, and have been shown to improve growth among under-five-year-olds. We examine whether staple subsidies lead to growth gains also in later childhood and how they vary by background vulnerabilities.

Methods

We leverage data on children aged 8–18 years ($N = 38,144$) from the longitudinal Indonesia Family Life Survey (1993–2015) to assess impacts of the rice subsidy program RASKIN (introduced in 1998) on household food access and children's medium-term height outcomes. Household fixed effects adjust for family background characteristics in a quasi-experimental study design. Heterogeneities across subgroups are investigated by interacting subsidy receipt with vulnerability indicators.

Findings

Staple food subsidies improved household food access and medium-term height outcomes. Past exposure to subsidies was associated with higher height-for-age z-scores (HAZ; 0.06, 95% CI: 0.02;0.11) and lower stunting prevalence (-4.64 percentage points, 95% CI: -6.74; -2.53) compared to unexposed siblings. Beneficial effects were concentrated in rural areas (HAZ increase 0.09 vs. 0.01 in urban areas, interaction $p = 0.02$) and households not using piped or purchased drinking water (0.09 vs. -0.05, interaction $p = 0.002$). No heterogeneity was observed by household wealth, maternal education, sanitation and child sex.

Interpretation

In addition to shorter-term benefits, childhood staple food subsidies improve height among 8-18-year-olds. Understanding the persistence of height gains over the medium term across vulnerability groups is essential for designing equitable nutrition policies.

Research in context

Evidence before this study

Chronic childhood malnutrition, often measured through impaired height growth, is associated with adverse health and cognitive outcomes across the life course. Many low- and middle-income countries employ staple food subsidies and some studies suggest that these subsidies are associated with improved food access and dietary diversity. Staple food subsidies have been found to be associated with improved height growth in early childhood, with heterogeneity by factors such as age and wealth. However, current evidence is limited in several respects: most studies focus exclusively on children under five without examining whether effects persist into later childhood and studies are geographically concentrated, primarily drawing from India. There is also limited

understanding of how the impact of staple food subsidy receipt on height growth may vary by vulnerability indicators.

Added value of this study

This study adds evidence on the effects of staple food subsidies on household food access and offers novel insights into longer-term impacts on height growth as well as contextual heterogeneities of these benefits in a Southeast Asian setting. Using longitudinal data in combination with a quasi-experimental design, we isolate the effect of an Indonesian rice subsidy program on height growth. Moreover, we investigate how these benefits were distributed across subpopulations by considering background vulnerabilities such as pre-subsidy food access, rural residence, access to drinking water and sanitation, socioeconomic status, and sex.

After documenting that staple food subsidies improved household food access, we demonstrate beneficial impacts on children's height growth in late childhood and adolescence, seven and more years after subsidy receipt. The benefits for growth from receiving staple food subsidies were larger for recipients living in rural areas and with limited access to clean drinking water. In contrast, no heterogeneities were found by household wealth, mother's education, sanitation and child sex.

Implications of all the available evidence

Staple food subsidies can improve household food access and height growth among young children, and beneficial effects on growth persist into adolescence. There is evidence for effect heterogeneity by certain living conditions in the medium term, while we found no heterogeneity by socioeconomic factors or child sex. Understanding how background vulnerabilities affect the distribution of nutritional benefits is thus useful for targeting and evaluating food security policies, both for shorter-term and longer-term outcomes. Unequal responses to policies, driven by background vulnerabilities, can reinforce health disparities, particularly in regions like Southeast Asia where malnutrition and poverty remain major public health challenges.

Introduction

Childhood nutrition has lasting effects on health across the life course.^{1–3} Addressing childhood malnutrition is therefore critical for improving long-term health outcomes. This is also reflected in the United Nations' Sustainable Development Goal 2, which calls for an end to all forms of malnutrition by 2030.⁴ Height growth, or linear growth, is used to assess long-term or chronic malnutrition because it captures sustained nutritional deficiencies rather than short-term fluctuations. Global commitments and the implementation of malnutrition mitigation policies have contributed to reductions in stunting in under-five-year-olds in Southeast Asia, from 35% in 2005⁵ to 23% in 2024⁶, however, malnutrition remains a public health challenge in the region.⁷

The adverse consequences of childhood malnutrition are well documented. While malnutrition affects all children, its prevalence is higher among those in socioeconomically disadvantaged settings. This results in a disproportionate impact in these populations, including in Southeast Asia.^{8, 9} Common social safety nets and food security policies in low- and middle-income contexts include cash transfers, vouchers and staple food subsidies. However, there is limited evidence in Southeast Asia on longer-term benefits of these policies using indicators for chronic child malnutrition, i.e. stunting or height growth, and little is known on socioeconomic disparities in their effectiveness.

One widely used anti-poverty and food security policy are staple food subsidies. These can counteract childhood malnutrition by improving food access, which can result in improved caloric intake.¹⁰ Staple subsidies can also improve micronutrient intake through improved dietary diversity^{11–14} since for households with fixed food budgets, lower staple prices may free up resources for more diverse foods. However, the opposite can also occur, i.e., lower staple food prices may increase consumption of staple foods while displacing other foods.¹⁵ Savings from subsidies might also be diverted to non-food items or to less healthy foods, limiting potential benefits for health and height growth.¹⁶

The literature on child nutrition interventions has focused more strongly on other policy tools, such as cash transfers, demonstrating benefits for food access as well as height growth, particularly among young children¹⁷. Despite the broad implementation of staple food subsidy programs, evidence on their health impacts remains scarce and largely limited to only one country, India. A few studies from India showed that staple food subsidies led to beneficial health impacts. Two studies investigated effects on height growth. One study on India's Public Distribution System, which subsidizes rice and sugar, found improvements in dietary diversity and reduced stunting among under-five-year-olds, particularly in the first two years of life and among asset-poor households.¹⁸ Another study, in contrast, found adverse impacts on height growth, especially among children living in wealthier households.¹⁰

To our knowledge, these studies on India are the only studies examining the impact of staple food subsidies on height growth, and there are no studies looking at effects beyond five years of age. Furthermore, little is known about whether such effects of staple food subsidies differ by socioeconomic background, by prior food access or by other indicators of vulnerability. Addressing these gaps is essential not only for assessing the effectiveness of staple food subsidy programs, but also for informing broader nutrition and social protection policies. This is particularly relevant in Southeast Asia, where malnutrition remains a health challenge despite substantial improvements in the past decades⁷, and where understanding the distribution and durability of nutritional benefits is essential for designing effective and equitable interventions.

In this study, we investigated the impacts of staple food subsidies on height growth among 8-18-year-old children and adolescents in Indonesia. For this purpose, we utilized Indonesia's long-running large-scale staple food subsidy program RASKIN (Rice for the Poor program – *Program Subsidi Beras Bagi Masyarakat Berpendapatan Rendah*), subsidizing rice, Indonesia's main staple food. RASKIN was launched in 1998 and allowed low-income households to purchase up to 20 kilograms of subsidized rice per month.¹⁹ In a first step, we assessed program impacts on household food access, using the Household Dietary Diversity Score (HDDS) and Food Consumption Score (FCS). Next, to study effects on height growth, we leveraged the panel structure of the Indonesian Family Life Survey (IFLS, 1993–2015) to compare height-for-age between siblings, where some were previously exposed to subsidized rice and others were not. This quasi-experimental study design reduces confounding from unobserved family background characteristics.

Another contribution of this study is that we go beyond average effects by investigating which subgroups of children benefit most from the subsidy receipt. Previous evidence on under-five-year-olds suggests that impacts are likely to differ across levels of vulnerability.¹⁸ We examined heterogeneity along four dimensions. First, pre-RASKIN household food access and nutrition may impact how strongly previous RASKIN receipt affects height growth in later childhood. We hypothesized that if prior food access was limited, individuals will likely benefit

more from food subsidy programs. Moreover, the nutritional environment during pregnancy may have an impact on how height growth responds to improved nutrition in childhood. As documented by an accumulating body of literature on the Developmental Origins of Health and Disease, nutrition during pregnancy not only influences early-life growth but has lasting effects on health outcomes throughout childhood and adolescence.²⁰

Second, effects may be heterogeneous by living conditions. Rural areas in Indonesia frequently encompass remote, food-insecure communities with limited infrastructure and restricted access to markets, leaving residents at greater risk of undernutrition.²¹ Additional indicators of living conditions are poor sanitary conditions and unsafe drinking water. Both can impair height growth by increasing susceptibility to infections.^{22–24} Third, low socioeconomic status is associated with limitations in both affordability of and knowledge about adequate diets.^{8, 25}

Finally, we investigated whether there are effect heterogeneities by sex. If there are differences in the distribution of household food resources with respect to child sex, the impacts on height growth could also differ. Likewise, the timing of growth spurts is sex-dependent²⁶, which may result in different responses of girls and boys to the subsidy.

By examining these subgroups, our study aims to not only provide evidence on the overall longer-term impacts of receiving staple food subsidies on height growth, but also elucidate how childhood food access and socioeconomic inequalities interact to influence nutritional outcomes in Indonesia.

Methods

Data

We used data from the Indonesian Family Life Survey (IFLS), a longitudinal study conducted by the RAND Corporation. IFLS was carried out in five waves: 1993/94 (IFLS1), 1997/98 (IFLS2), 2000 (IFLS3), 2007/08 (IFLS4), and 2014/15 (IFLS5).^{27–30} The data include information on individual height measurements of children conducted by trained nurses, household food expenditures, purchases of subsidized rice made through the RASKIN program, as well as detailed family and household characteristics.

Sample

Our individual-level sample comprised children aged 8–18 years, enabling an assessment of medium-term effects of staple food subsidy receipt on height growth. We linked current height measurements to prior household participation in RASKIN. Since IFLS was fielded at seven-year intervals after the introduction of RASKIN in 1998, we observed RASKIN participation in previous waves for children who were at least 8 years old at the time of measurement. Accordingly, 8-18-year-old children exposed to RASKIN in one or two previous waves were between 1 and 11 years old during the period in which their household purchased subsidized rice. Of 40,938 children and adolescents in this age group, 95% had height measurements and 94% had biologically plausible height measurements³¹, yielding a final sample of 38,492.

We further constructed another sample at the household level to assess impacts of subsidy receipt on household food access, using the same subset of households with children aged 8 to 18 years. This sample

includes 24,967 observations on 11,836 households and indicators of household food access in the respective survey wave (see “Outcomes”).

Variables

Outcomes

Food access was assessed using two measures: Household Dietary Diversity Score (HDDS) and Food Consumption Score (FCS). IFLS households report on food expenditures over the previous seven days before an interview. The HDDS reflects the number of different food groups purchased out of 12, and consequently ranges from 0 to 12.³² By contrast, the FCS is a weighted measure, capturing the consumption frequency of nine food groups, with weights assigned based on nutritional value (e.g., legumes receive a higher weight than sugar) and ranges from 0 to 112. According to the adjusted thresholds for countries with high oil/sugar consumption, values of 0–28 are classified as comparably low, 28.5–42 as borderline and 42.5–112 as comparably high.³³

We assessed child nutritional status using height-for age z-scores (HAZ), which measure the number of standard deviations a child’s height deviates from the median height of a global reference population of the same age and sex. The scores were calculated using the World Health Organization’s (WHO) growth charts. In accordance with WHO definitions, we also constructed binary indicators for stunting ($HAZ < -2$ SD) and severe stunting ($HAZ < -3$ SD).^{31, 34}

Exposure

Exposure was defined as household participation in the staple food subsidy program RASKIN, which allowed low-income households to purchase up to 20 kg of subsidized rice per month. RASKIN, formerly known as *Operasi Pasar Khusus* (OPK), started in July 1998 as a nation-wide subsidized rice distribution program, i.e. after IFLS2 had been fielded and before IFLS3 began.^{19, 26, 27} Starting with IFLS3, data are available on household purchases of subsidized rice during the preceding 12 months.

We constructed the exposure measure at the individual level as an indicator for whether a child lived in a household that reported purchasing subsidized rice in either the previous wave (7 years earlier) or two waves earlier (14 years earlier). Due to the way the RASKIN program was implemented, many households received subsidized rice continuously or for extended periods. This indicator should thus not be interpreted as reflecting receipt exactly seven or fourteen years prior to a height measurement, but more broadly as a proxy for past RASKIN exposure. It is also important to note that no data on RASKIN participation were collected between IFLS waves, so we are unable to observe subsidy receipt in the intervening years.

We also constructed an indicator for current exposure to the RASKIN subsidy (“RASKIN currently”), coded as one if the household reported subsidized rice purchases within the past 12 months before a child’s height measurement. While we did not expect current RASKIN receipt to have an immediate impact on HAZ (as height reflects long-term nutritional status), this variable is included as a covariate in all models (see “Statistical analyses”). This is important because current receipt is correlated with previous RASKIN purchases and can

serve as a proxy for time-varying unmeasured family characteristics. Moreover, we cannot rule out that current RASKIN receipt is associated with our outcomes. First, height growth could respond within a year to improved nutrition, and second, many households that currently receive RASKIN will have started doing so over a longer preceding period. We therefore report associations of current RASKIN receipt with our outcomes, even though our main interest is in the exposure measure of having received RASKIN in the past.

Covariates

We adjusted for child's sex, household size, household wealth (log assets) and religion (Muslim vs. any other religion). We further included wave dummies, child age at measurement (in months) as well as its square to adjust for time. The reason for this is that both our outcome and our exposure are correlated with time trends: stunting prevalence decreased over time, and RASKIN receipt (which might be correlated with poorer height growth) increased over time. We furthermore adjusted for household fixed effects. This means that our identification strategy relied on within-household variation in RASKIN participation, so that household characteristics that remain stable over time were implicitly adjusted for (see "Statistical analyses").

Statistical analyses

RASKIN receipt and household food access

To assess the impacts of the staple food subsidy on height growth, we first studied associations between current RASKIN participation and household food access in the same survey wave using the household-level sample. We estimated ordinary least squares (OLS) regressions with RASKIN purchases in the current wave at the household level as explanatory variable, and the two indicators for household food access (HDDS and FCS) as outcomes. All covariates as described above as well as the household fixed effects were included.

Past RASKIN receipt and height growth

We next examined the effects of the RASKIN subsidy on children's HAZ, as well as on stunting and severe stunting using the individual-level sample by conducting OLS regressions with household fixed effects. The use of household fixed effects is a key element of our empirical strategy. Including household fixed effects implies that the analyses relied solely on comparisons between children within the same household (i.e. mostly siblings) who differed quasi-randomly in RASKIN exposure due to being born in different years and variation in households' exposure to the program across communities and over time, resulting from changes in targeting and differences in implementation at the local level. This approach is important to reduce confounding by household-level characteristics such as socioeconomic status, parental education or general food insecurity, which are both targeted by RASKIN and influence child growth. This implies that we did not compare children across households: Analyses that compare children in recipient vs. non-recipient households are at high risk of bias, since household participation in subsidy programs is based on characteristics that at the same time affect nutritional outcomes. By including household fixed effects, we restricted comparisons to children within the same household, adjusting for all household characteristics that remain constant over time, whether observed (e.g., pre-RASKIN household characteristics such as household education) or unobserved (e.g., parental attitudes toward nutrition).

Specifically, this means that differences in height growth outcomes were identified by changes in RASKIN participation within households across survey waves so that confounding due to the program's targeting of low-income households was minimized. Note that the set of covariates additionally includes current RASKIN participation, household wealth and size, variables that can change over time within households, and that can affect the likelihood that a household will receive RASKIN. Adjusting these time-varying factors further decreases the risk of residual confounding.

Heterogenous height growth responses across subgroups

To assess whether the impacts of RASKIN receipt on children's height growth varied across subgroups and levels of vulnerability, we re-estimated the main regression model with interaction terms between RASKIN receipt and indicators of vulnerability. For all the vulnerability indicators, we constructed binary variables.

First, we looked at vulnerability by pre-RASKIN food access and nutrition. We measured baseline household food access using the last observed Food Consumption Score (FCS) before RASKIN implementation (i.e. in IFLS 2, or if missing, in IFLS1), and classified households at or below the wave-specific median as exhibiting poor food access. To measure a nutritional factor during pregnancy, we exploited the fact that Indonesia is a predominantly Muslim country. Many pregnancies coincide with Ramadan, the Muslim holy month, with the majority of Indonesian pregnant Muslims adhering to the fast.^{35, 36} Ramadan during pregnancy has been shown to have lasting effects on childhood and adolescent health, including height growth.^{37–40} Following the literature, children were classified as prenatally exposed if they were Muslim and their prenatal period (266 days prior to the birth date) overlapped with a Ramadan.

Second, we examined disparities along living conditions, namely rural residence as well as sanitary and drinking water access. The WHO/UNICEF Joint Monitoring Programme (JMP) defines “at least basic” drinking water access as the use of an improved source with a collection time not exceeding 30 minutes per round trip, including queuing.⁴¹ Because direct measures of collection time are unavailable in the data, we estimated time using distance. For households whose main drinking water source is located inside their house, the 30-minute threshold is clearly satisfied. For households with off-premises sources, assuming a conservative walking speed of 2.5-3 km/h, a one-way distance of 1.3 km corresponds to the JMP threshold of 30 minutes. We find that more than 98% of households with reliable information on distance in the IFLS either have their main drinking water source inside their house or a one-way distance of no more than 1.3 km. We thus assumed that the distance criterion was also fulfilled by households with off-premises sources. Improved sources include piped water, boreholes, protected wells and springs, rainwater, and packaged or delivered water. We could not fully operationalize this as IFLS does not contain information on whether wells and springs are protected, and more than half of all household in our dataset used wells or springs as their main drinking and cooking water source. We thus constructed a binary indicator for use of piped, purchased, or rainwater, which can be unambiguously classified as improved in accordance with JMP methodology.⁴²

For sanitation, we also could not fully operationalize the “at least basic” service level of the JMP sanitation ladder, which requires both an improved and non-shared facility. While JMP defines improved facilities based on information on the type of toilet and the type of sewage system, IFLS only contains information on whether a non-shared toilet has a septic tank. For this reason, we constructed a binary indicator for access to a private

(i.e., non-shared) toilet. Both drinking water access and access to a private toilet were defined based on the first observed household value in the IFLS dataset.

Third, we investigated socioeconomic vulnerability using household wealth and maternal education. Household wealth was defined as a binary indicator for assets above the median in the first observed wave and the education indicator measured whether the mother had completed at least junior high school (approximately 9 years of schooling) or less. Finally, we examined sex-specific impacts by interacting the RASKIN variables with a binary variable indicating the sex of the child.

Role of the funding source

The funders had no rule in study design, data collection, data analysis, interpretation, and writing of the report.

Results

Sample characteristics

The main analytic sample included 38,492 observations of children and adolescents with valid height-for-age z-scores (Table 1, Part A). Their mean height-for-age z-score was -1.7 and 37% were classified as stunted. While 32% of children resided in households reporting RASKIN purchases within the 12 months preceding their height measurement, 20 % of children had been exposed to RASKIN in prior survey waves.

Households had about five members and nearly half of households were located in urban areas (Table 1, Part B). Stunting prevalence was higher in rural than in urban areas (44% vs 29%). Average HDDS amounted to approximately 9 (out of 12 maximum points) and average FCS to 29 (out of 112 maximum points), which is just above the threshold for a low FCS.³³ Slightly more than half of households had access to a private toilet and a quarter of households used piped, purchased or (in a few cases) rain water.

RASKIN receipt and household food access

Households that purchased subsidized rice in the 12 months before an interview reported higher food access during the past week in the respective survey wave, as compared to the same households' food access in survey waves without program participation (Table A1). Average scores were 0.13 (95% CI: 0.06;0.20) higher for HDDS and 0.58 (95% CI:0.19;0.96) higher for FCS. Note that the strength of the reported effect may be underestimated because there is a mismatch between RASKIN receipt, which was measured via a question asking about receipt in the past 12 months, and food access, which was measured over the past seven days. The resulting measurement error likely attenuates the reported estimates.

Table 1. Characteristics of 38,492 children (aged 8-18 years) residing in 11,836 households, Indonesian Family Life Survey, 1993-2015

	Mean (SD)	N
A. Individual characteristics		
Age (in years)	13.2 (3.2)	38,492
HAZ	-1.7 (1.0)	38,492
Stunted, %	36.9	38,492
Severely stunted, %	9.1	38,492
RASKIN currently, %	31.9	38,492
Past RASKIN receipt, %	19.8	38,492
Male, %	49.8	38,492
Muslim, %	88.6	38,490
Mother completed at least junior high school, %	28.2	34,726
Ramadan during pregnancy, %	60.1	38,492
B. Household characteristics		
Household Dietary Diversity Score (HDDS)	9.30 (2.0)	24,967
Food Consumption Score (FCS)	28.6 (10.4)	24,967
Pre-RASKIN food access above median, %	53.4	18,356
Living in urban area, %	46.6	24,967
Household size	4.9 (1.9)	24,967

Household assets (log)	16.5 (1.9)	24,967
Access to a private toilet, %	53.3	24,967
Use of piped, purchased or rain water, %	24.8	24,967

Abbreviation: SD, standard deviation, HAZ, height-for-age z score. Stunted: HAZ<-2, severely stunted: HAZ<-3. HDDS: number of food groups consumed per household per week (0-12), FCS: weighted number of food groups consumed per household per week (0-112), Pre-RASKIN food access above median: FCS>median FCS (in the wave before RASKIN implementation), Household assets: logarithm of sum of reported assets in a wave, Access to a private toilet: non-shared own toilet.

Past RASKIN receipt and height growth

The average HAZ among children exposed to household subsidy receipt in preceding waves was 0.06 (95% CI: 0.02;0.11) higher than among children in the same households without prior RASKIN exposure. Their prevalence of stunting was 4.6 percentage points (95% CI: -6.74; -2.53) lower, and their prevalence of severe stunting was 3.2 percentage points (95% CI: -4.55; -1.91) lower. By contrast, for current participation in the subsidy program, there was only strong evidence for an association with severe stunting (Figure 1, Table A2).

Pre-subsidy food access and nutrition

Figure 2 and Table A3 present results from regressions including interactions between RASKIN purchases and vulnerability indicators. Positive associations between past RASKIN receipt and HAZ (0.09, 95% CI: 0.03;0.15) were observed among children residing in households with higher baseline food access (FCS above the median before the introduction of RASKIN), whereas no clear associations were identified for households with below-median baseline food access (0.04, 95% CI: -0.02;0.11), though there was no evidence for effect heterogeneity (interaction p = 0.23). There was also no evidence that the association between subsidy receipt and HAZ differed between children prenatally exposed to Ramadan and those not exposed (interaction p=0.46).

Living conditions, SES and sex

Regarding place of residence, past RASKIN receipt was positively associated with HAZ among children living in rural areas (0.09, 95% CI: 0.05;0.14), while no such association was found for children living in urban areas (0.01, 95% CI: -0.05;0.08), with evidence for heterogeneity (interaction p=0.02). No interaction was found for sanitation (interaction p = 0.73), with subsidy receipt associated with HAZ both among children living in households with and without access to a private toilet. When considering drinking water access, positive associations between past RASKIN receipt and height for age were only found among children living in households that did not use piped, purchased or rain water (0.09, 95% CI: 0.04;0.13) but not in those who used these improved drinking water sources (-0.05, 95% CI: -0.14,0.03, interaction p=0.002). The analyses interacting previous RASKIN purchases with household wealth, mother's education and child sex did not suggest

heterogeneous responses in height growth (all interaction p-values 0.30 or higher), with similar improvements in all subgroups.

Discussion

In this study, we examined the medium-term health effects of staple food subsidies on height growth among 8-18-year-olds in Indonesia. Access to subsidized rice was associated with increased household food access at the time of subsidy receipt. Several years later, children who had been exposed to the subsidy exhibited higher height-for-age z-scores and lower prevalence of stunting and severe stunting, indicating medium-term gains in child growth.

This study contributes to the literature in three ways. First, we add rare empirical evidence on the health impacts of staple food subsidies in a Southeast Asian context where stunting remains prevalent. We did so by investigating the effects of a large-scale and long-running Indonesian program, RASKIN, which provides subsidized rice for the poor. Second, we explored how these effects vary depending on vulnerabilities, providing insights into the contextual conditions under which such an intervention is most effective. Third, we not only add empirical evidence but strengthen causal evidence in this field: We leveraged a large longitudinal dataset and used a quasi-experimental design which exploited within-family variation in RASKIN exposure status. Employing household fixed effects allowed us to compare siblings within the same household who differed in RASKIN exposure due to date of birth, program timing and within-family eligibility changes. This approach reduced confounding from household-level factors influencing both program participation and growth outcomes.

Despite substantial reductions in malnutrition, stunting remains widespread in Southeast Asia, with 23% of under-five-year-olds stunted in 2024.⁶ Prevalences during the study period from 1993 to 2015 had even been higher, and in our sample⁵, 37% of children aged 8-18 years were stunted. This indicates considerable malnutrition, although genetic population differences in height also come into play in adolescents.^{43, 44} Our results suggest persistent gains in height growth in response to staple food subsidies: Stunting prevalence among RASKIN-receiving children was 4.6 percentage points lower than for non-receiving children.

Given the marginal gain from an extra unit of food access is larger when baseline food access is low, we expected height growth gains from RASKIN to be strongest among children in worse nutritional conditions. We also expected effects to be stronger among more vulnerable groups, including those facing adverse living conditions such as poorer sanitary and drinking water access as well as in households with lower socioeconomic status. Our empirical results reveal a more complex picture.

Contrary to expectations, children living in households with relatively low pre-RASKIN food access did not experience greater gains in height growth in response to the program than children from households with better food access, and there was even weak evidence suggesting smaller gains among them. This may reflect that, although food access increased across all subgroups, the magnitude of the increase was insufficient to produce substantial improvements in height growth among children in households with low pre-subsidy food access as measured by the FCS, or that other factors necessary for growth were lacking, e.g. access to sufficient micronutrient-rich food.

Supporting our hypothesis, we found larger improvements in height growth in response to RASKIN receipt among children living in rural areas than among children in urban areas. Rural households in the IFLS exhibited

a higher child stunting prevalence than their urban counterparts (44% vs 29%). In Indonesia, rural households are often not only characterized by lower food access but also by lower access to safe drinking water and sanitation.²¹ A poor water, sanitation and hygiene (WASH) environment can facilitate exposure to enteric pathogens, increasing infection risk and contributing to impaired nutrient absorption and linear growth.⁴⁵ We find that RASKIN staple food subsidies have larger effects among those using drinking water from sources that could be unambiguously classified as improved following JMP methodology (predominantly piped or purchased water), but found no effect heterogeneity by sanitation quality, proxied by access to a private toilet.

We did not find differential height growth responses by household wealth and maternal educational level, suggesting the program supported height growth across socioeconomic groups. Lastly, our analyses did not suggest any sex-specific effects of subsidies on children's height growth, which is in line with our expectations, as systematic differences in intra-household food allocation between boys and girls have not been reported in Indonesia.

There are several limitations to our research, leading to bias towards the null. First, the data on RASKIN receipt are not very detailed. We only observe RASKIN receipt every seven years and therefore do not know the exact timing and length of the period over which RASKIN was received. Moreover, we do not have information on the frequency and quantity of subsidized rice purchases but could only classify households according to whether or not they participated in RASKIN. Second, the calculation of HAZ required age in months, which we derived from the interview date and the recorded birthdate. For records lacking day of birth, we imputed the 15th day of the respective month. This will have led to a limited degree of measurement error and only concerned 0.16 % of observations in our sample. Third, we use a quasi-experimental research design in which we compare children within the same household of whom some had been exposed to RASKIN and others not because they had been born in different years. This comparison within households has a considerable advantage over comparing between households, given that poorer households, where children are on average shorter anyway, are more likely to receive the subsidy. Of course, families' circumstances will change over time. To deal with potential confounding from this, we control for time of observation, age and age squared, as well as household assets. Nevertheless, some degree of residual confounding may remain. Because economically worse-off families are more likely to receive RASKIN, this would lead to an underestimation of the effects.

It should also be noted that we only know whether a household bought subsidized rice during the 12 months preceding a survey wave, but that we lack information on the extent to which specific individuals within that household actually benefited from the improved food access. While it would have been of great value to have more information on this, this limitation does not bias our estimates with respect to the question we address, i.e. whether a broad food staple subsidy program leads to health benefits among children. If households had responded to the subsidy by replacing micronutrient-rich foods with staple foods, we would not have seen improvements in food access measures or in height growth. Our results indicate that this is not a major issue, given that household's access to different food groups did improve. Similarly, if only adults had profited from the staple food subsidies, we would not have seen effects on children's height growth either. As we have no data on the exact mechanism, we treat the process by which food is allocated within households as a black box. What we can conclude, however, is that children do benefit from the staple food subsidy. Future research is needed to better understand the underlying pathways.

Overall, improved food access through staple food subsidies is only one factor among many determinants of child growth. Our results show that broadly targeted staple food subsidies for the poor can lead to medium-term health benefits, though these benefits were focussed on rural areas and households without access to piped or purchased drinking water. Risk factors for malnutrition are context-specific and can encompass both early and later life circumstances⁸, making it worthwhile to examine the persistence of nutritional effects into adolescence, a period sensitive to the nutritional environment and critical for growth and development.⁴⁶ Further research should therefore consider a broader range of health and cognitive outcomes, evaluating both shorter- and longer-term effects to understand the enduring impact of receiving staple food subsidies.

As benefits of staple food subsidies are likely to differ across contexts¹⁸, analyses that account for diverse socio-economic and environmental conditions – including household living environments, crises, extreme weather events, climate change and climate-driven food insecurity – could offer valuable insights for policymakers. It is therefore important to acknowledge the compounded vulnerability of marginalized populations, who are not only more likely to experience malnutrition but are also disproportionately exposed to adverse environmental conditions. Integrating these dimensions into the design of food security strategies and social safety nets – including staple food subsidies – is essential to come closer to achieving zero hunger and healthy lives for all.

Declarations

Availability of data and materials

The data analysed in this study are publicly available and can be accessed through the RAND Corporation website at <https://www.rand.org/health/surveys/FLS/IFLS/access.html>. The analysis code is available from the authors upon reasonable request.

Competing interests

The authors declare no competing interests.

Funding

This work was supported by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) – Project number 455841434. F.P. was supported by the High-Potential Research Areas “EXPOHEALTH” and “Interdisciplinary Public Policy” at the Johannes Gutenberg University Mainz, which are funded by the Ministry of Science and Health of Rhineland-Palatinate, Germany.

Ethics declaration

This study is a secondary analysis of publicly available, de-identified data from the Indonesia Family Life Survey (IFLS). The present study did not involve the collection of new data from human participants and therefore did not require additional ethical approval. The IFLS underwent human subjects protection review by the RAND Human Subjects Protection Committee (IRB) and the participating institutions in Indonesia before data collection. The RAND Human Subjects Protection Committee approval number is s0064-06-01-CR01.

Ethics approval and consent to participate: not applicable

Consent for publication: not applicable

Authors' contributions

S.G., R.v.E. and F.P. conceived the study idea and designed the research. N.H. conducted the analyses with input from all authors. N.H., F.P. and R.v.E. drafted the manuscript. All authors discussed the results, read and edited the manuscript, and approved the final version of the manuscript.

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Figures

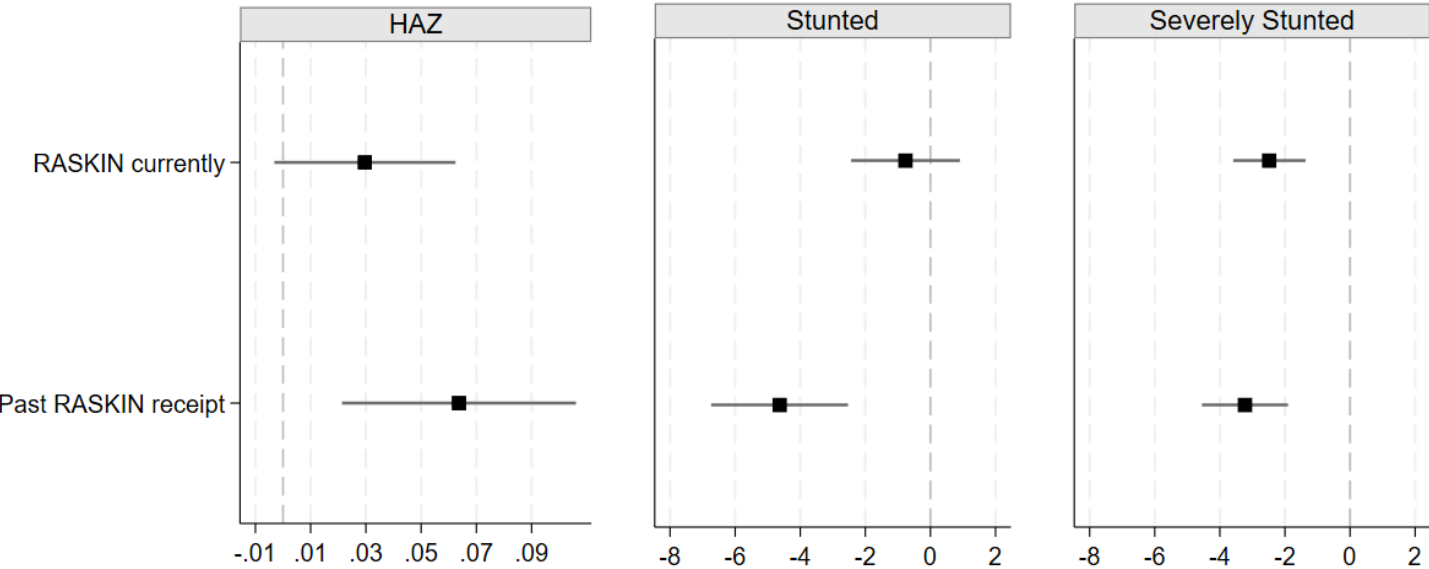


Figure 1

Effect of the RASKIN staple food subsidy program on height growth. Squares show point estimates, horizontal bars 95% confidence intervals. The upper squares and bars show the coefficients and CIs for current RASKIN participation, and the lower squares and bars for past RASKIN receipt. Regressions were adjusted for wave, sex, child age (in months), age squared, Muslim religion, household size, household assets (log-transformed) and include household fixed effects. Standard errors were clustered at the household level. Results for the binary variables, stunted and severely stunted, should be interpreted as changes in prevalences (percentage point changes). Coefficients for these variables are multiplied by 100. Stunted: height for age z-score (HAZ)<-2, severely stunted: HAZ<-3. Number of observations: 38,144, Number of households: 11,836. Numeric results can be found in Table A2.

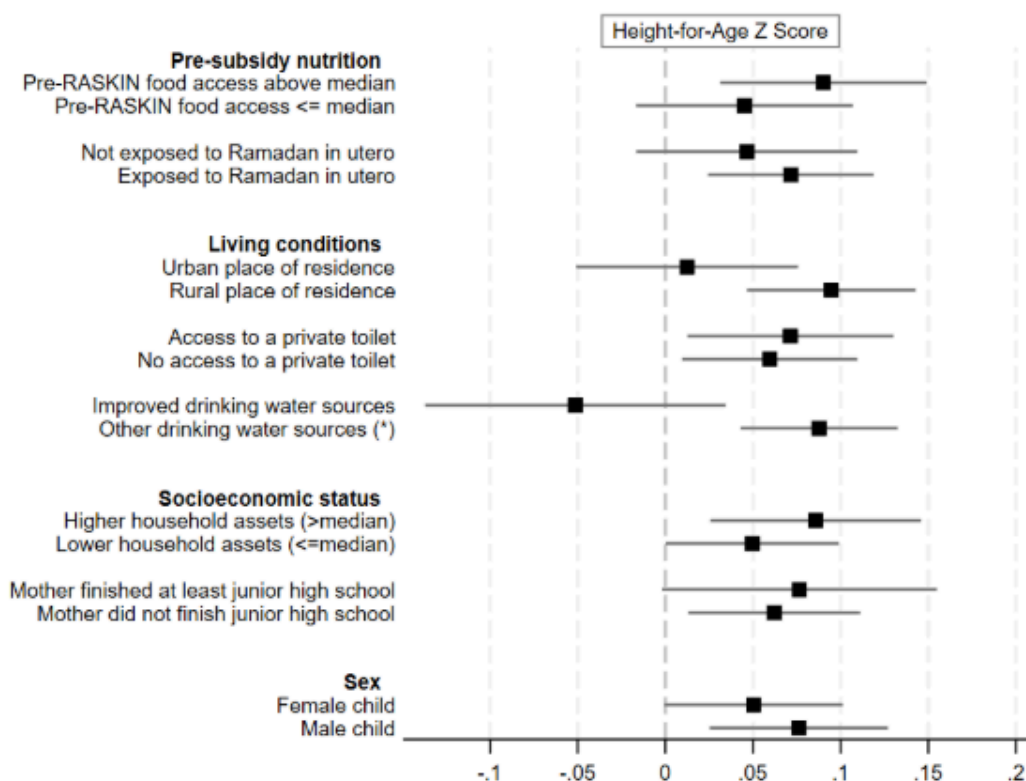


Figure 2

Effect of the RASKIN staple food subsidy program on height growth – by vulnerability indicators. Squares show the point estimates, horizontal bars the 95% confidence intervals. Each panel shows results from one single regression, providing the stratum-specific effect estimates for the indicated subgroups. Regressions were adjusted for wave, sex, child age (in months), age squared, Muslim religion, household size, household assets (log-transformed) and include household fixed effects. Standard errors were clustered at the household level. Number of observations: 38,144, Number of households: 11,836. Numeric results and interaction p-values are shown in Table A3.

(*) Improved drinking water sources are those that could unambiguously be classified as such (piped, purchased and rain water). “Other drinking water sources” includes some unimproved, and some potentially improved sources.

Supplementary Files

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