

IEA COMPASS: BRIEFS IN EDUCATION

HUNGER AND LEARNING ENVIRONMENT

Global Patterns in Student Hunger and Disorderly Behavior in Math Lessons



SUMMARY

It is well understood that when students are experiencing hunger, their ability to learn suffers. What is less understood is why this is the case and the role of the learning environment. Using TIMSS (Trends in International Mathematics and Science Study) 2019 data, this brief examines how student hunger is correlated with how disorderly the classroom environment is during math lessons. Even though the data does not allow us to unpack why students come to school hungry, we found a consistent relationship between hunger and disorderly classroom environment, without any exception, across 38 TIMSS 2019 participating countries. This relationship holds even after controlling for differences in student and classroom socioeconomic status, class size, teacher experience, and educational attainment. These findings suggest that when students come to school hungry, they have a harder time paying attention and regulating their behavior. This can result in a disorderly and less effective learning environment for all students, even those not experiencing hunger.

Authors

Yusuf Canbolat, Indiana University
Leslie Rutkowski, Indiana University

IMPLICATIONS

- ▶ Across many countries that participated in TIMSS, including highly industrialized ones, student hunger is a prevalent issue. About one in three eighth graders feel hungry every day or almost every day when they arrive at school. This ratio raises to about one in two students in countries such as Chile and Romania. Even in countries with high income and low child poverty, such as Republic of Korea and France, there are still high rates of student hunger.
- ▶ If students feel hungry, having a more experienced and educated teacher or studying in smaller classes may not be enough to change the level of disorderly behavior in their math lessons. Therefore, preventing hunger is a precondition to ensure quality instruction for all students.
- ▶ Decision-makers in all TIMSS-participating countries should prioritize addressing hunger in schools in their policy agenda and consider putting hunger alleviation on par with other policy alternatives to improve the learning environment.
- ▶ To fight against student hunger during their learning period, countries should consider high-quality nutrition programs aligned with food assistance and school meal programs, so that children's nutritional needs are also met outside of school hours. Effective nutrition programs require successful collaboration between the decision-makers from a wide range of sectors including education, health, agriculture, finance, and social protection.

INTRODUCTION

Given persistent income inequalities, poverty, and the cost of healthy food, more than eight hundred million people face hunger around the world. Further, because of the COVID-19 pandemic and conflicts around the world, the situation has worsened in recent years (UNICEF, 2022). Though hunger affects wide segments of societies, children are more likely to face hunger than adults due to their vulnerability to limited financial resources, and higher odds of living in poverty (UNICEF, 2020).

The conventional wisdom is that child hunger is a unique issue for developing and high-poverty countries (Alderman et al., 2006). However, even economically-developed countries fail to ensure food security for a substantial share of children (Pollard & Booth, 2019). Results from TIMSS 2019 show that about one in three eighth graders feel hungry every day or almost every day when they arrive at school. This ratio raises to about one in two students in some countries such as Chile, Romania, Republic of Korea, and France (Figure 1).

Countries with high-income inequality and poverty tend to have higher rates of self-reported student hunger; however, the relationships between those income indicators and the prevalence of student hunger are modest in magnitude (see Figures 2.a. and 2.b.). Further, although the frequency of hunger varies across countries, the issue is not limited to relatively high-income inequality, high poverty, or economically less developed countries. Instead, hunger is prevalent in a wide range of countries.

The widespread issue of hunger across countries raises concern about how it might create barriers to learning. Indeed, much is known about the individual effect of hunger on children. Studies have found that hunger may weaken cognition, memory, and long-term brain development, creating a substantial achievement gap between students (Aurino et al., 2020; Basch, 2011; Canbolat et al., 2023; Frisvold, 2015). However, what is much less known is whether student hunger might be related to more macro-level contexts, such as the learning environment. When students experience poor nutrition, it is harder for them to listen, concentrate, and learn since hunger adversely affects attention and cognition. Thus, a higher level of average hunger may be associated with a disruptive learning environment (Jensen, 2013), which in turn might impair learning, since a positive disciplinary climate provides safeguards for quality instruction and improved student achievement (Nilsen et al., 2016).

Using TIMSS 2019 data, this brief examines how self-reported student hunger is correlated with disorderly behavior in their lessons. We begin our analysis with the descriptive relationship between student hunger and disorderly behavior in math lessons. Building on these descriptive results, we further examine the relationship using multilevel regression. In short, we found a consistent relationship between hunger and disorderly behavior without any exception across 38 TIMSS 2019 participating countries. This relationship holds even after controlling for differences in student and classroom socioeconomic status, class size, teacher experience, and educational attainment. We further describe these findings subsequently.

Figure 1: Percentage of students that report feeling hungry when they arrive at school: every day or almost every day (eighth grade/TIMSS 2019)

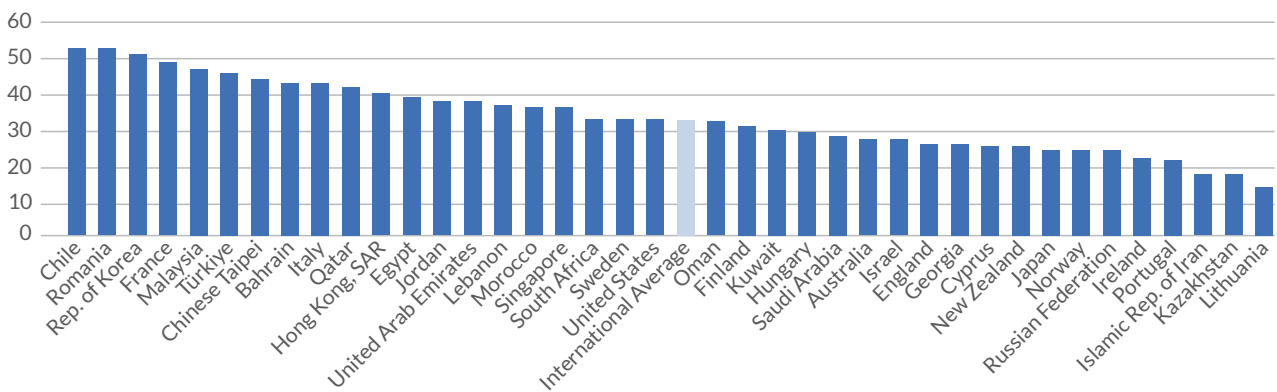


Figure 2.a: The relationship between income inequality and self-reported student hunger across countries (N=36)

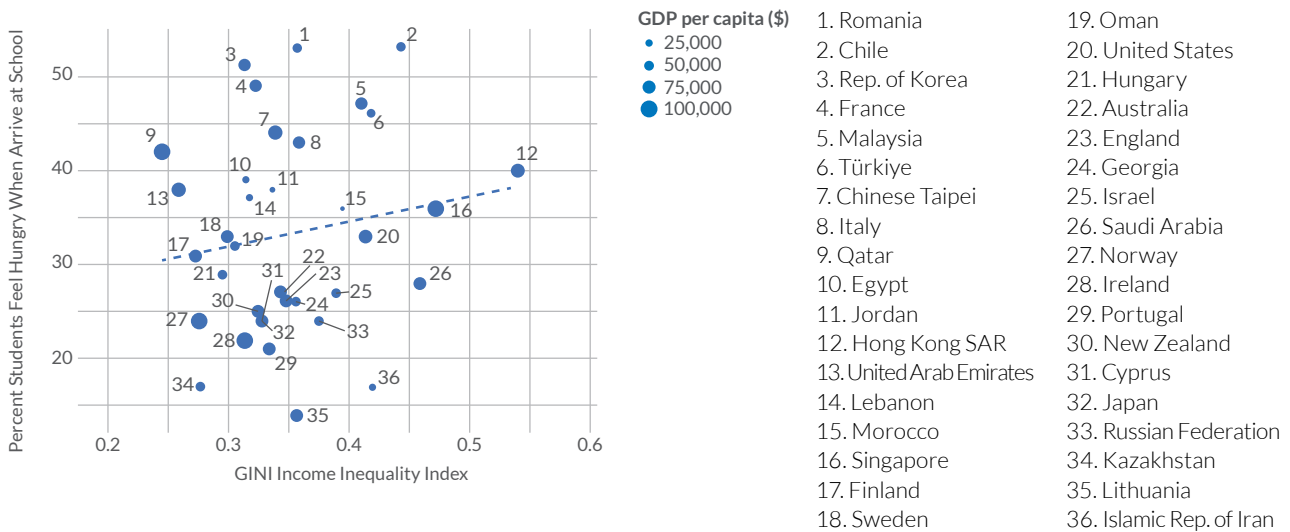
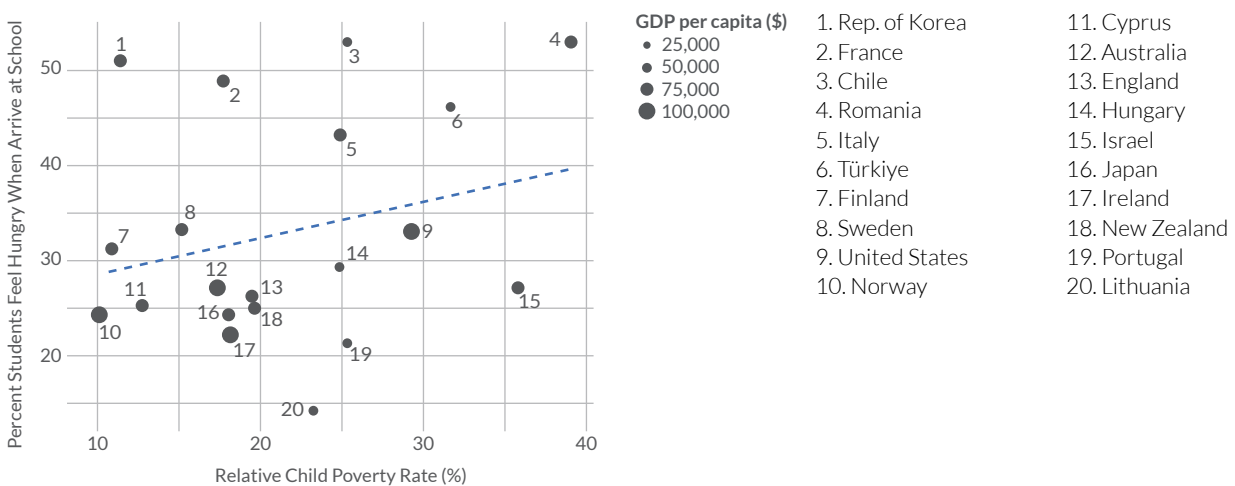


Figure 2.b: The relationship between relative child poverty and student hunger across countries (N=20)



► **Notes:** The relative child poverty rate shows the proportion of each country's children living in a household where disposable income is less than 60% of the national median. Gross domestic product (GDP) per capita values for GDP expressed in current international dollars converted by purchasing power parity (PPP) conversion factor. The correlation coefficients in Figure 2. a and 2. b are .15 and .26, respectively. For two countries, Bahrain and Kuwait, there is no comparable income inequality index. Comparable relative child poverty data is available for 20 countries. Source: The World Bank, 2022a, 2022b; UNICEF, 2017; and TIMSS 2019 international database. Authors' analysis.

DATA & SAMPLE

Students are asked how often (*every day, almost every day, sometimes, never*) they feel hungry when they arrive at school. Following the TIMSS 2019 International Report (Mullis et al., 2020), we aggregate the two hunger categories, *every day* and *almost every day*. Thus, the frequency of hunger consists of three categories: *never* (1), *sometimes* (2), and *every day* or *almost every day* (3). Higher values describe more frequent hunger. TIMSS 2019 student questionnaires have six items about disorderly behavior in math lessons. These Likert-type items collect information about how often (*never, some lessons, about half the lessons, every or almost every lesson*) students do not listen to what teachers say, there is disruptive noise, it is too disorderly for students to work well, the

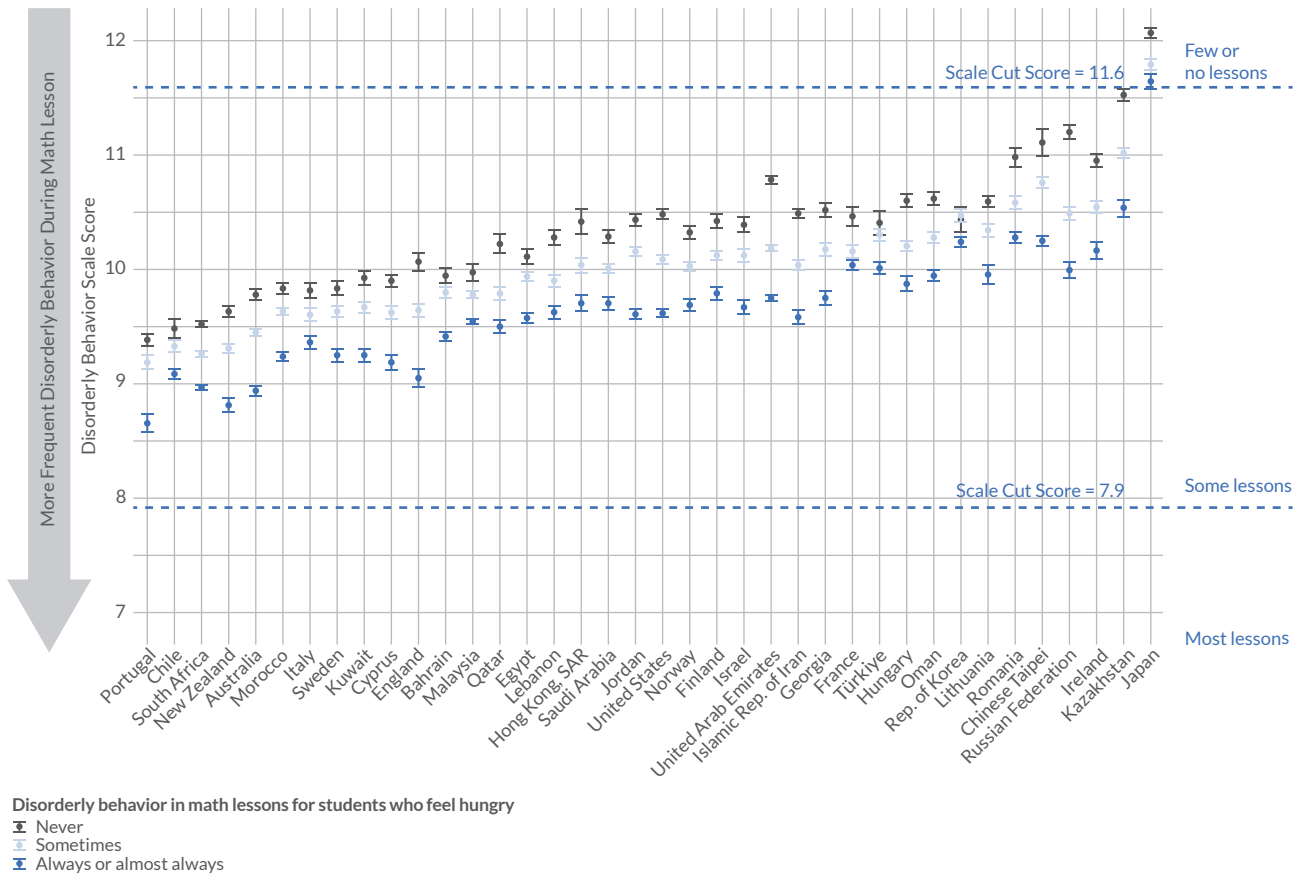
teacher has to wait a long time for students to quiet down, students interrupt the teacher, and the teacher has to keep telling students to behave (Mullis et al., 2020). We use the *Disorderly Behavior During Mathematics Lessons* scale created by TIMSS, based on students' responses to these six items. TIMSS uses two cut scores to distinguish disorderly behavior into three categories. A scale score lower than 7.9 is identified as disorderly behavior in most lessons; higher than 11.6 indicates few or no lessons; those between 7.9 and 11.6 indicates disorderly behavior in some lessons (Yin & Fishbein, 2019). The sample of the study consists of eighth-grade students from 38 participating countries in TIMSS 2019. There are 222,492 students from 10,619 classes and 7,483 schools in the sample.

► **The Relationship Between Self-Reported Hunger and Disorderly Behavior in Math Lessons**

Figure 3 illustrates disorderly behavior during math lessons by the frequency of student-reported hunger across countries. Based on disorderly behavior cut-off scores, on average, only Japan has disorderly behavior in few or no lessons. The mean disorderly behavior in all other countries is in some lessons. Among TIMSS 2019 countries, the most frequent disorderly behavior during math lessons is in Portugal, Chile, and South Africa.

In all countries, students who report more frequent hunger experience a higher level of disorderly behavior in their math lessons (Figure 3). Without any exception across 38 countries, students who report that they are always or almost always hungry report the highest disorderly behavior in their math lessons compared to their peers. Likewise, students who report feeling hungry sometimes report higher levels of disorderly behavior than those who never feel hungry when they arrive at school.

Figure 3: Disorderly behavior during math lessons by frequency of hunger



► **Notes:** Lower values correspond to more disorder. Dots show mean disorderly behavior scale score. Spikes show standard errors of means. Countries are ranked by mean disorderly behavior in descending order from left to right (i.e., Portugal has the highest; Japan has the lowest disorderly behavior during math lessons). A scale score lower than 7.9 is identified as disorderly behavior in most lessons; higher than 11.6 indicates few or no lessons; those between 7.9 and 11.6 indicate disorderly behavior in some lessons.

Though this brief focuses on the relationship between self-reported hunger and disorderly behavior, other factors like student and class socioeconomic composition, class size, teacher experience, and educational attainment may influence the learning environment (Pianta et al., 2002). The cross-sectional nature of the data prevents us from isolating hunger as a cause of disorderly behavior. However, to check whether the relationship of interest is confounded by those factors, we fit two multilevel regression models in which students are nested within the classes, in line with the TIMSS sampling design (Mullis et al., 2020). The first model (Model I) examines the relationship between hunger and disorderly behavior without controlling for any other factors. The second model (Model II) accounts for student and classroom SES (socioeconomic status), teacher experience, teacher educational attainment, and class size.

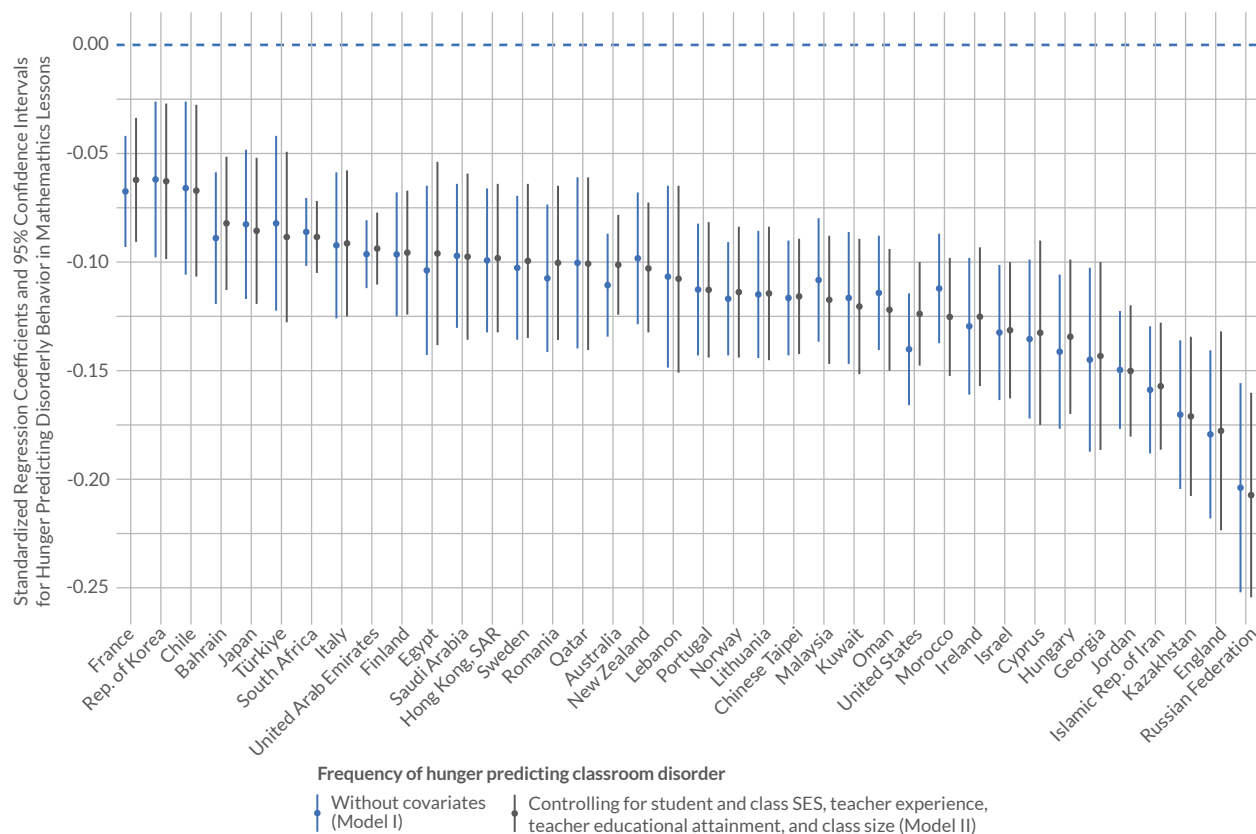
Comparing the results from these models enables us to examine whether the relationship between hunger and classroom disorder is confounded by those factors. To ease the interpretation, we use standardized regression coefficients. The results are reported in Figure 4.

Model I in Figure 4 shows that one SD (standard deviation) increase in hunger frequency (i.e., *never*, *sometimes*, and *always*) correlates with more than 0.10 SD increase in classroom disorder in most countries. In some countries and school systems such as Islamic Republic of Iran, Kazakhstan, England, and Russian Federation, the magnitude of the relationship is larger than 0.15 SD. On the other hand, in other countries such as France, Republic of Korea, and Chile, the magnitude of the relationship is close to 0.05 SD.

Model II in Figure 4 shows that the relationship between hunger and disorderly behavior is robust to the inclusion of other factors in all countries. The magnitude of the relationship between the frequency of hunger and perceived disorderly behavior does not substantially change in any country between Model I and Model II,

which includes no covariates and accounts for other teacher, and class characteristics, respectively. This result means the higher level of experienced disorder by hungry students is not related to the student SES, socioeconomic composition of classes, teacher experience, educational attainment, and class size.

Figure 4: Relationship between hunger and classroom disorder, multilevel regression results



► **Notes:** Lower values of regression coefficients correspond to a stronger negative relationship between hunger and disorderly behavior in math lessons. Countries are ranked by the magnitude of the relationship between hunger and disorderly behavior in order of coefficient strength from left to right (i.e., the relationship is strongest in the Russian Federation). Dots are the fixed effect standardized regression coefficients for hunger and spikes are 95% CI from the multilevel regression estimation. Regression coefficients for student and class SES, teacher experience, teacher educational attainment, and class size from multilevel regression are not plotted for clarity. Both models use student and class weights. Student weights are scaled so that the sum of weights is equal to the number of students in the class.

CONCLUSIONS & IMPLICATIONS FOR RESEARCH & POLICY

Our analysis shows that student hunger consistently correlated with a poorer learning environment in math lessons. Regardless of teacher and class characteristics, students who stated that they were hungry report higher levels of disorderly behavior in their math lessons, potentially impeding their opportunities to learn. Even though the magnitude of the relationship between hunger and disorderly behavior varies across countries, there is a consistent and universal pattern between them. Given the large share of students who report hunger when they arrive at school, hunger prevents a meaningful share of students from focusing on their lessons in all TIMSS 2019 countries across a wide economic and social spectrum.

To better understand the role of student hunger, further research is needed on how student hunger affects other dimensions of the learning environment and instructional quality, such as cognitive activation and supportive learning environment (Nilsen et al., 2016). In addition, there is little known about the mediating role of individual and macro-level factors to explain the relationship between hunger and student achievement. As a macro-level factor, understanding the mediating role of disorderly behavior to explain the relationship between hunger and achievement requires additional research.

An important limitation of our study is that we do not know why the students come to school hungry. For example, although hunger is largely associated with lower SES, in some cultures, it may be that breakfast is not a normal part of the local diet. Also, we do not know that students are necessarily learning while hungry. Our data does not capture nuances of the issue such as whether schools offer breakfast or whether students bring their breakfast packs to schools. In those cases, students may be hungry when they arrive at school but not during class time. A more comprehensive measure of student hunger in international large-scale assessments can address these limitations.

One of the key policy implications of our study is that preventing hunger is a precondition for ensuring quality instruction. Results indicated that if students feel hungry, having socioeconomically more advantageous peers in the class and a more experienced and educated teacher or studying in smaller classes may not change the level of disorderly behavior in their math lessons. In other words, hunger in the classroom creates a barrier to quality instruction. Therefore, our results suggest that decision-makers should prioritize addressing hunger in their policy agenda and consider putting it on par with other policy alternatives to improve the learning environment.

Nutrition programs play a key role in addressing student hunger. They improve the neediest households' ability to access healthy food. Depending on the purpose, resources and beneficiaries,

countries embrace various modalities such as in-kind food assistance, cash transfers, and food vouchers (Lentz & Barrett, 2013). Also, community-based education can promote nutrition knowledge, and positive attitudes toward healthy food thereby improving dietary intake (Dollahite et al., 2014; Rivera et al., 2019). Experimental studies indicate that students who eat a protein-rich breakfast feel lower hunger for longer hours (Qiu et al., 2021). Consequently, parents' knowledge and skills to make more informed decisions when choosing foods can mitigate the negative effect of limited time and financial resources.

Schools should consider offering high-quality nutrition programs for students and parents. Empirical evidence suggests that school-based nutrition education can improve their dietary habits. To improve the effectiveness of those interventions, schools should ensure a rigorous curriculum, offer teacher training, and incentivize parental involvement (Prelip et al., 2012). Aligned with other nutrition programs such as food assistance and school meal programs, nutrition education can contribute to reducing student hunger. The policies require effective collaboration between the decision-makers from a wide range of sectors including education, health, agriculture, finance, and social protection (Global Child Nutrition Foundation, 2022; Vilson & Schieder, 2018). With sufficient resources from local, national, and international resources, such collaboration can ensure that children's basic human needs are being met to participate and fully engage in school.

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IEA Amsterdam
Keizersgracht 311
1016 EE Amsterdam
The Netherlands

By email: secretariat@iea.nl
Website: www.iea.nl



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