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Health Policies as Education Policies? A Review of Causal Evidence and Mechanisms

Maithreyi Gopalan
Rohitha Edara
The Pennsylvania State University

Despite lagging behind other high-income countries, the United States has made slow but steady improvements in health, especially for children from low-income households, through a series of health policies and programs since the 1990s. Have these health benefits spilled over to educational attainment and achievement? In this article, we systematically review the causal impact of various health policies and programs on children's educational outcomes in the United States. We find that several health policies and programs aimed at improving the physical health of children and parents have modest spillover effects on key educational outcomes for school-age children. On the other hand, there is a paucity of research on policies aimed at improving children and adolescents' mental health (and limited evidence on their efficacy on educational outcomes where research exists). We contextualize the effects of these health policies by providing benchmarks from other education policies and conclude with some key open questions and suggestions that can guide research and policymaking at the health-education nexus.

Keywords: *achievement, causal inference, economics of education, education policy, educational policy, effect size, health policy, human development, policy, policy analysis, quasi-experiments, systematic review*

Introduction

One of the most rigorous cost-benefit analyses of social policies in the United States finds that policies targeting children's education *and* health provide the "biggest bang for the buck" from a public policy standpoint (Hendren & Sprung-Keyser, 2020). Indeed, it finds that Medicaid expansions to pregnant women and infants are as (if not more) cost-effective than high-quality early childhood education, primarily due to large spillovers[1] across education and health domains over a child's life course. Similarly, demographers often consider educational attainment to be a key social determinant of health and a fundamental cause of health disparities (Hayward et al., 2015; Link & Phelan, 1995). Although there is an increasing appreciation for the bidirectional relationship between health and education (Lynch & von Hippel, 2016), research and policymaking within the two sectors often seem siloed, with less attention being paid to cross-policy spillovers. In this review, we examine the educational effects of health policies and provide a more holistic framework for researchers and policymakers to deeply engage with the links between health and educational development across the life course.

Our review contributes to the existing literature in several ways. First, existing reviews at the intersection of health and education policy are restricted to reviews of maternal and neonatal health interventions affecting early childhood health and subsequent schooling outcomes (Currie & Rossin-Slater, 2015; Prinz et al., 2018). However, these reviews have a narrow focus and do not explore the full range of intersectional ties between health and education. This review encompasses a wider range of health policies and programs as well as studying the impacts on children from birth to adolescence. Second, most of the studies included in prior reviews examine a limited number and type of educational attainment measures, such as high school graduation or number of years of education. Our review takes a more holistic approach toward educational outcomes by including other measures, such as test scores, absenteeism, grade repetitions, discipline outcomes, and postsecondary enrollment. Third, over the last two decades, several health and nutritional policies have been evaluated using randomized control trials (RCTs) and quasi-experimental research designs (QEDs).[2] This provides us an opportunity to review the causal impact of health policies on educational outcomes. To that end, in this study, we systematically review, analyze, and contextualize the effects of health policies and programs—such as health insurance access and expansions, broad- and school-based nutritional policies, and environmental health-promoting policies aimed at improving children's and adolescents' physical and mental health—on subsequent educational outcomes.

Finally, because of the paucity of such broad-based systematic reviews of health policy effects on educational outcomes, we also lack clarity on the mechanisms through which child and adolescent health affects subsequent well-being. For example, prior reviews of maternal and neonatal health interventions combined with emerging evidence about developmental plasticity suggest that early-life health interventions are particularly effective in improving cognitive skills in children (Currie & Rossin-Slater, 2015). However, several questions remain. Do educational effects of policies affecting children's physical health differ from those influencing mental health? What are the intergenerational processes through which parental health and well-being, enabled by health policy levers, affect children's educational outcomes? How do these health policy spillover effects on education compare to the effects of direct educational policies on educational achievement and attainment? Further, how can we move research in this area to explore meaningful interactions across these policy domains? We hope to provide answers to some of these questions in this article. More importantly, we hope that our review spurs further conversations on this topic of significance. In the following section, we briefly describe our search process and inclusion/exclusion criteria, and we clarify some key definitions of policies and programs we use.[3] Later, we review research measuring the (plausibly) causal effect of health policies and programs on educational outcomes and describe the key potential mechanisms driving these effects. Then, we contextualize the effects of health policies/programs on education outcomes by comparing them to direct educational interventions. In the final section, based on our findings, we discuss outstanding questions and the infrastructure needed to answer them effectively.

Systematic Review Search Process: Definitions and Inclusion/Exclusion Criteria

Our review process aimed to identify all studies that examine the causal effect of a health policy or program on educational outcomes across the Pre-K–16 education spectrum. We use broad National Institutes of Health definitions of *policy* and *program* in our review. Specifically, "Policy is broadly defined to include both formal public policies at local, state, and federal levels of government, and organizational level policies, such as those implemented by large organizations, worksites, or school districts"; "Program is defined as a set of activities such as implementation of system-level interventions, tools, or guidelines initiated by governmental or other organizational bodies, within public or private entities in local, state, or federal jurisdictions" (Hunter, 2022). As described earlier, we limit our inquiry to the health policy/program evaluation literature that uses an experimental or quasi-experimental research design to tease out plausibly causal effects rather than descriptive associations. Furthermore, studies also have to include key educational outcomes as primary/secondary outcomes of interest in the evaluation. Our systematic review process to identify literature on this topic uses a search strategy encompassing education-related (e.g., academic achievement, advanced placement) and health policy–related (e.g., Medicaid, school lunch) terms (see online Appendix A for the exact search string, the journal databases, inclusion/exclusion criteria, and the forward/backward search strategies used). To capture the latest research in the field, we restrict the search to articles published from 2000 to 2020. In all, we end up with a final list of 58 articles. The detailed results of these 58 articles are also tabulated in Table A2 in the online appendix.

As with all systematic reviews, we have to make some subjective decisions on what counts or does not as a health policy/program to manage the scope of this broadly defined review. For example, we do not include studies in our review that evaluate policies/programs—such as violence-reduction policies including gun violence or social policies that aim to reduce child abuse or neglect—given that their target sample is much smaller as compared to those likely affected by broad-based health policies/programs. Further, cash-supplement policies (e.g., earned income tax credits, child support) are also excluded, given that these policies do not explicitly target health and are much broader in scope. Although these policies could eventually work through the health channel to improve educational outcomes, we consider those as beyond the scope of this review. We also provide further clarifications regarding such inclusions/exclusions and our reasoning behind those decisions as needed while discussing the evidence pertaining to certain classes of health policies/programs.

Review of Evidence and Mechanisms

How do public policies aimed at promoting health affect children's educational outcomes, such as academic performance and overall educational attainment? In our systematic review of the literature, we identify two plausible channels: (a) a direct channel—improving the physical and mental health of children enables them to learn better; and (b) an indirect channel—policies targeting better health and well-being of parents promote investment in children's education.

We further categorize the *indirect channels* into three distinct groups: (a) development of better physical health, in utero and across childhood through better exposure to health and nutrition policies; (b) promotion of better mental health and socioemotional well-being, including through the diagnosis and treatment of mental health and intellectual disabilities; and (c) promotion of better health through access to environmental health policy/programs enabling exposure to fewer toxic contaminants. Next, by *indirect channels*, we

mean mechanisms that involve changes in household economic resources and/or parental practices associated with a health policy/program lever that might affect children's and adolescents' educational outcomes. For example, the availability of additional economic resources as a result of public/subsidized health policies might increase investment in education, especially for low-income families. Further, programs that improve parental well-being or parenting behaviors can influence family processes that promote children's health and education. We discuss each of these mechanisms below, using studies identified in our review as exemplars. Understanding which of these mechanisms are effective may explicate clearer policy implications and inform future policy design and implementation.

Better Physical Health Aids Cognitive Development

There is a robust literature on the long-term, life-course effects of early childhood health on adult health and economic well-being (see Currie & Rossin-Slater [2015] for a review). Here, we extend our analysis to examine the educational benefits of policies/programs aimed at promoting better child and adolescent health. From our review, four major types of policies/programs, originally aimed at improving the physical health of children and adolescents, also show educational effects: (a) policies that provided and/or expanded free/subsidized health insurance, (b) immunization policies aimed at preventing infectious diseases, (c) school heath programs aimed to promote better health, and (d) nutritional policies and programs aimed at alleviating food insecurity.

Public Health Insurance and Healthcare Expansions. One of the largest public health policies that improved access to healthcare for low-income households in the United States prior to the most recent Affordable Care Act (ACA) expansions in 2014 was the State Children's Health Insurance Program (SCHIP) of 1997. Earlier reviews of the SCHIP program have shown significant improvements in use of healthcare by parents and children (Howell & Kenney, 2012; Miller & Wherry, 2019). We focus our review on examining whether improved health access and utilization translate to educational outcomes. Although that literature is admittedly smaller, we do find evidence from evaluations of the SCHIP expansions showing that subsidized health insurance provisions reduce absenteeism (Yeung et al., 2011), modestly improve children's reading achievement (Levine & Schanzenbach, 2009), and increase educational attainment in terms of years of schooling as well as college enrollment (Brown et al., 2020; Cohodes et al., 2016; Groves, 2020). Research has also shown that early health insurance coverage that covers the prenatal period and the first year of life reduces the probability of a child being below grade for their age (Qureshi & Gangopadhyaya, 2021). The positive effects of such early health insurance access to children also extend to high school graduation (Miller & Wherry, 2019).

Although early health insurance coverage seems consequential for a variety of educational outcomes, there are some exceptions, resulting in a lack of clarity on the mechanisms by which benefits accrue. For example, Levine and Schanzenbach (2009) find positive effects of SCHIP on elementary and middle schoolers' reading test scores but null effects on their math performance. Although these results are somewhat in line with past literature on children's development—which points to an outsized role of processes outside school mattering for reading achievement, as opposed to schooling-related processes mattering more for math achievement (Jacob, 2005)—more research is warranted to further clarify the mechanisms at play. Similarly, some of (but not all) the above studies show that a reduction in absenteeism (Alexander & Schnell, 2019) due to improved health enabled by better healthcare access might be a key mediating mechanism for improving children's and adolescents' educational attainment.

Evaluations of broader provisions and expansions in healthcare access to historically disadvantaged demographic subgroups, such as Black children, have also been carried out, yet evidence from these studies is mixed. For example, two studies by Chay and colleagues (2009, 2014) show a positive causal effect between hospital desegregation in the South in the 1960s and Black children's academic outcomes. However, recent replications of these policy efforts using alternative data sets and research designs have raised concerns about the identification strategy used in those studies and largely find null effects (D. M. Anderson et al., 2020).

Immunization. Preventive health practices, such as immunizations that expanded dramatically through mandatory school vaccination laws in the United States in the 1960s and 1970s, improve high school graduation rates as well as the overall number of years of schooling (Lee, D. N 2012). In the case of well-identified preventive health policy evaluations, our review suggests that a primary mechanism through which immunizations affect educational attainment is also by reducing absenteeism (Plaspohl et al., 2014), thanks to a successful reduction of the targeted diseases. Concerningly, recent studies that evaluate the effects of policies that exempt parents from mandatory vaccinations also show that cohorts of children exposed to these policy changes experience negative effects on math and reading test scores in middle school (Hair et al., 2021).

School-Based Health Programs. Early in our search process, two types of studies emerged: studies that examine broad-based, whole-school health programs, such as the Coordinated School Health Program, and more specific programs, such as physician consultations for asthma diagnosis and treatment and nurse case management

interventions in schools (Levy et al., 2006; Splett et al., 2006). Some of these studies reported significant reductions in absences, such as among students exposed to better asthma diagnosis and treatment, but most suffered from fairly limited sample size and were thus excluded from our final review. Indeed, we find only a few causal evaluations of school-based health programs with a sufficient sample size that includes educational outcomes of interest. For example, studies on provision of primary healthcare through school-based health centers report mixed success (Lovenheim et al., 2016). Although school-based health centers significantly reduce teenage fertility rates, these effects do not seem to spill over to high school graduation rates or academic performance. Similarly, light-touch health screening mandates, such as vision screening and care in schools, also do not seem to significantly affect education outcomes. For example, Glewwe et al. (2018) find that enhanced vision services seem to improve students' math and reading passing rates by about 2% in elementary schools in the United States. Nevertheless, whether these effects are sustained and how they compare to expansion of broad-based health insurance and healthcare access outside schools need further attention.

Nutrition Programs. In low and middle income countries (LMICs), early childhood nutrition policies have long been known to affect academic achievement primarily through an improvement in learning productivity per year of schooling (Glewwe et al., 2001). In the United States, the Supplemental Nutrition Assistance Program (SNAP) is a key nutritional policy aimed at reducing food insecurity and improving the health of children from low-income households. Although they are not strictly health policies, nutrition policies emerged in our review of the literature as being health-adjacent because these programs significantly reduce food insecurity among children, thereby promoting their health (see Holley & Mason [2019] for a review). Recently, studies have examined whether these policies have spillover effects on children's educational outcomes, such as academic achievement, grade repetitions, and school disciplinary infractions, using QEDs. For example, Chorniy and colleagues (2020) find that early childhood access to SNAP reduces the incidence of grade repetitions in middle school. Studies that exploit the variation in the timing of SNAP benefit cycles for low-income families also find that access to SNAP benefits improves children's academic achievement (Cotti et al., 2018; Gassman-Pines & Bellows, 2018) and reduces school suspensions and expulsions (Gennetian et al., 2016). Consistently, studies find that children's educational outcomes are negatively affected toward the end of the benefit cycles—that is, when the elapsed time from benefit receipt increases. This leads to important insights regarding policy design and implementation. In other words, more frequent disbursals of benefits (in addition to the overall amount of benefits) might matter when it comes to the design and implementation of nutritional policies targeting low-income households.

Similarly, nutrition policies that target school-aged children in the United States through the provision of healthy breakfast and lunch in schools have also shown some positive effects on student performance (Anderson et al., 2018; Frisvold, 2015; Hinrichs, 2010). Although evidence is mixed regarding whether these policies also increase obesity (Corcoran et al., 2016; Schanzenbach & Zaki, 2014), consistent positive effects are seen on achievement for all children (from low- and high-income households). This shows that increased calorific content and nutrition-driven health benefits are associated with better academic performance in school. Most recently, studies have also highlighted the broad benefits of expanding the access of school-based nutritional programs to high-poverty schools through the Community Eligibility Provision (CEP). Findings from CEP evaluations using QEDs show that it has a small positive effect on academic performance of students from low-income families (Gordanier et al., 2020; Ruffini, 2022; Schwartz & Rothbart, 2020), specifically on math test scores. CEP has also been associated with reductions in school suspensions and expulsions (Gordon & Ruffini, 2021).

However, not all school-based meal provision policies show similar positive effects. For instance, several states have implemented policies/programs to increase access to school breakfast by moving the provision of breakfast to the classroom. Yet most of the research on Breakfast in the Classroom initiatives shows no significant changes in academic performance (Anzman-Frasca et al., 2015; Corcoran et al., 2016; Dotter, 2013; Schanzenbach & Zaki, 2014), with the exception of one study that finds some minor improvements in math and reading achievement (Imberman & Kugler, 2014). Similarly, expansions in eligibility for breakfast programs in schools also seem to largely have null effects (Leos-Urbel et al., 2013; Ribar & Haldeman, 2013). This could be because Breakfast in the Classroom–type initiatives encourage students to eat second breakfasts or substitute meals at home, thereby resulting in largely null effects. These results further point to the need for careful attention to policy design. Specifically, the consideration of counterfactual conditions (i.e., what would have happened in the absence of the policy) with keen attention to alternative comparison groups helps more holistically assess policy-relevant causal effects. More research examining multiple comparison groups and replications using alternative data or research designs in this area is needed to explicate why some policies seem to show small positive effects while others result in largely null effects.

In all, our review of broad-based health and nutritional programs shows that these policies seem to demonstrate small but consistently positive effects on students' educational outcomes. Specifically, broad-based policies that

enhance children's health, even beyond early neonatal health interventions, seem to have protective effects for children's educational performance and attainment. However, school-based health programs show more heterogeneous effects that vary across policy design and implementation parameters, highlighting the need for more careful attention to separate selection effects from correlational estimates.

Limited Research on the Effects of Adverse Mental Health on Educational Attainment

Children with behavioral/mental health problems (as compared to those with physical health ailments) are more likely to have academic difficulties (Prinz et al., 2018). Yet studies that evaluate the educational effects of policies/programs targeting childhood mental/behavioral health were much harder to find in our review of the literature. Nevertheless, we focus on three large classes of policies/programs that emerged in our review that target mental/behavioral health broadly to improve educational outcomes—(a) policies/programs aimed to improve diagnosis and treatment of attention deficit hyperactivity disorder (ADHD), (b) special education programs targeting students with disabilities and/or special needs, and (c) policies/programs aimed to improve diagnosis and treatment of depression and anxiety among adolescents.

Diagnosis and Treatment of Attention Deficit Hyperactivity Disorder. ADHD, the most prevalent childhood mental health disorder, has been the focus of a few studies that use longitudinal models and sibling fixed-effects designs. These studies have uncovered associations between ADHD diagnoses and grade repetitions as well as higher enrollment in special education (Currie & Stabile, 2006). However, fewer studies evaluate policies/programs that involve changes in the timing of diagnosis and treatment of mental health–related disorders. They also seem to show limited success in improving educational outcomes. For instance, a study that evaluates the policy of a Canadian province expanding health insurance access to include stimulant medication for treatment of ADHD finds few beneficial effects on educational attainment (Currie, Stabile, & Jones, 2014). Indeed, this study hypothesizes that community-level harm might be caused through increases in stimulant use, especially when combined with null educational effects. Similarly, increased access to private therapy for Michigan students with emotional difficulties also seemed to show rather limited success in improving educational performance (Acton et al., 2021).

Special Education Services. Special education is a widely studied education topic, with entire journals dedicated to examining the various facets of special education programs. Because special education programs are quite broad and combine academic support with mental/behavioral health support components, they cannot be considered health policies/programs in the strictest sense. Yet excluding these important programs at the health-education nexus—mapping the contours of which is a primary goal in our review—seems imprudent. Therefore, we limit our focus to studies that evaluate the causal impact of special education programs on the educational outcomes of students with disabilities that have come about due to a change in the diagnosis/access to special education programs through a health policy/program change lever.[4]

Prior research on students with disabilities who newly received access to special education programs in early school grades showed mixed evidence (Hanushek et al., 2002). More recently, research is beginning to uncover the positive impact of special education programs on math and English/language arts (ELA) scores (Ballis & Heath, 2021; Schwartz et al., 2021) through the use of QEDs and administrative data linkages. For example, Schwartz et al. (2021) find improvements in math and ELA scores among students with learning disabilities who are newly classified to participate in special education programs. Similarly, Ballis and Heath (2021) find that a state-level policy change in Texas that limited the placement of students in special education was particularly harmful for students from minoritized backgrounds, resulting in reductions in high school graduation and enrollment in college. In all, our review further highlights the need for more causal research to improve the evidence base in this area.

Diagnosis and Treatment of Depression and Anxiety in Adolescence. Studies that causally link adolescent mental health programs and educational attainment are even more limited. For instance, studies that use longitudinal models and sibling fixed effects (that essentially control for common, family-level confounding factors) find a connection between adolescent depression and high school graduation and college enrollment (Fletcher, 2008, 2010). Yet research that evaluates the effects of policies/programs that change the diagnosis or treatment of depression and anxiety on educational outcomes is virtually nonexistent. Our review uncovered only two papers that assess the impacts of mental health treatment on educational outcomes. First, smaller, targeted randomized interventions that combine mentoring with insights from cognitive behavioral therapy evaluated in school settings for disadvantaged students seem to show tremendous promise in improving students' academic achievement and reducing their likelihood of dropping out of high school (Cook et al., 2014). However, we exclude this study from our review due to its small sample size. We encourage larger replications of these studies that show promise. Similarly, mental health treatments for justice-involved youth also seem to show some potential in improving educational outcomes (Cuellar & Dave, 2016). We should continue to

examine the scalability of such programs across various contexts.

Further, recent evidence on socioeconomic disparities in access to mental healthcare treatments for adolescents within and across neighborhoods (Cuddy & Currie, 2020) highlights the need for additional research in this area. Overall, our review of the limited literature examining the causal linkages between children's and adolescents' mental health and their subsequent educational achievement echoes earlier calls for action, highlighting limited evidence, lack of cohesiveness, and fragmentation between public health and educational interventions (Cuellar, 2015).

Finally, in addition to research on programs addressing mental health issues, research is highly needed regarding the precise mechanisms through which these associations are manifested. The most credible explanation from the above research is that depressive symptoms significantly increase the likelihood of disengaging from school and dropping out. Given the large negative effects attributed to this mechanism (25%–30% increase in the likelihood of dropping out of high school; Prinz et al., 2018), research focused on understanding the processes leading up to lower educational attainment is warranted.

Modest but Significant Positive Effects of Mitigating Environmental Risk Factors

Another important set of policies targeting maternal and child health includes environmental policies aimed at reducing children's exposure to pollutants. Specifically, a host of studies show the positive health effects of pollution-mitigating policies, especially early in children's life course (Currie, Zivin et al., 2014). Do those positive health effects translate to better educational achievement and attainment? A complete review of all environmental policies that affect children's health and, consequently, their educational trajectories is beyond the scope of this article. However, in this section, we discuss the key policies and mechanisms that have been studied and clearly linked to educational outcomes, using causal research designs. Specifically, we focus on policies that identify health-related mechanisms hypothesized to be key mediators, such as lead abatement and other pollution-mitigation programs.[5]

Pollution-mitigation efforts directly aimed at improving air quality in schools through mold removal, ventilation improvement, and school bus engine retrofitting projects have been causally linked to improved test scores by 0.07–0.20 standard deviations (SDs; Austin et al., 2019; Gilraine, 2020; Stafford, 2015). These findings are in line with earlier studies linking pollution and student performance in high schools and colleges in other countries, such as the United Kingdom (Roth, 2016) and Israel (Ebenstein et al., 2016).

Similarly, emerging research shows that students attending schools near industrial plants and toxic release inventory sites experience negative effects on test scores (0.024 SD) as well as increased likelihood of suspensions (Persico & Venator, 2021; Persico et al., 2020). More recently, however, research using quasi-experimental methods has quantified the link between exposure to lead in early childhood and later academic performance (Aizer et al., 2018; Billings & Schnepel, 2018; Sorensen et al., 2019). On average, from the above studies, we find that lead-abatement programs improve math and ELA scores in Grades 3–8 by about 0.04–0.11 SD and 0.08–0.11 SD, respectively.

The literature on prenatal and early childhood exposure to pollution (specifically, lead) more broadly finds even larger negative effects on test scores and subsequent long-run outcomes of children, highlighting the need for structural interventions to reduce exposure to environmental pollution, broadly defined (Ferrie et al., 2012; Gazze et al., 2020; Isen et al., 2017). The potential mechanisms through which environmental toxicity affects educational outcomes are largely categorized into two large buckets—(a) sustained exposure to pollutants, especially early in the life course, affects development; and (b) exposure-related, shorter-term negative effects on health affect cognitive processes. For example, air pollution has largely been hypothesized to increase absenteeism and reduce cognitive achievement (Heissel et al., 2022). On the other hand, lead pollution might increase cognitive deficits and the likelihood of disability diagnoses. Indeed, more studies should examine the mechanisms through which outcomes are affected and potential heterogeneity in effects by race/ethnicity and socioeconomic status. In all, given the disproportionate exposure of minority and low-income households to toxic pollutants, school-based, pollution-mitigating programs/policies are an environmental justice issue. However, these environmental health policies that target children seem to be a promising avenue to improving educational outcomes as well.

Emerging Evidence on Other "Indirect" Channels: Educational Effects of Health Policies/Programs Targeting Family

As described earlier, beyond the direct channels of health policies/programs connecting improvements in physical and mental health in childhood and adolescence with better educational outcomes and attainment, some of the health policy levers we synthesize above (e.g., health insurance expansions) also open other indirect channels that can improve children's educational outcomes. Two such indirect mechanisms that have been explored in the literature include the availability of additional household economic resources and other family engagement processes likely induced by the policy/program initiatives. In this section, we describe health policies/programs largely targeting families that likely affect children's educational outcomes through such family-functioning mechanisms.

Direct Public Health Interventions Targeting Maternal and Postnatal Wrap-Around Services. A public health program that has been evaluated using RCTs is the Nurse-Family Partnership (NFP) program (Ayoub et al., 2009; Jones Harden et al., 2012; Raikes et al., 2006; Roggman et al., 2009). Although sample sizes in these studies are quite limited, in general, NFP programs are one of the most cost-effective interventions in this domain due to their large, longer-term, life-course effects. On average, these programs improve children's school-readiness outcomes and subsequent academic outcomes, especially for boys. They promote educational outcomes, often through changes in maternal and child health as well as by improving parenting behaviors, such as parental time allocated for cognitive stimulation of children (see Heckman et al., 2017). Although several states have strong NFP programs, family access is still not universal and likely uneven. Similarly, Early Head Start (EHS)—a federal program that began in 1995 as small, demonstration projects—has expanded across the country. EHS was designed to target low-income parents as well as children. Known as a two-generation program, EHS aims to improve children's development by strengthening their families through a range of wrap-around services, including home visits, parenting education, healthcare referrals, and case management. Despite variation across programs (some are home-based, while others are center-based and/or a combination), randomized evaluations of these programs find significant positive impacts on child and parenting outcomes (Love et al., 2005). However, not all home-visiting programs seem to show similar promise, especially on children's socioemotional skills. For example, the Comprehensive Child Development Program provides family-centered services to low-income households, with the specific goals of promoting developmentally appropriate, caregiving, and parenting behaviors. The Comprehensive Child Development Program, however, did not affect children's growth trajectories when compared to a randomized control group that did not receive these programs (Goodson et al., 2000).

Changes in Family's Health, Economic Well-Being, and Functioning. As mentioned earlier, health policy levers—such as better health insurance access—could also improve educational outcomes for children through improvements in parental health and economic well-being. For example, low-income adults in states that expanded Medicaid access through the ACA report better health outcomes compared to those in non-expansion states (Gopalan et al., 2022; Soni et al., 2020). They also report increases in economic resources due to a reduction in financial barriers to healthcare (Glied et al., 2020). Similarly, Lombardi et al. (2022) find that low-income parents who gained eligibility for Medicaid under the ACA experienced decreases in children's medical expenses. Improvements in economic well-being are significant when there is a reduction in medical expenses and/or debt for low-income families. Given that medical expenses can form a significant portion of a low-income family's budget, such improvements in economic well-being are associated with positive educational outcomes among children and adolescents across a wide variety of studies (see Brooks-Gunn & Duncan, 1997).

Recent policy evaluations of nutritional policies also find similar positive effects, flowing primarily through better maternal health. For example, maternal access to the Special Supplemental Nutrition Program for Women, Infants, and Children lowers the incidence of children repeating grades as well as diagnosis of ADHD (Chorniy et al., 2020). A key proxy measure of child physical health used in many of these studies is birth weight, which is causally linked to subsequent cognitive achievement (Figlio et al., 2014) and disability diagnoses (Elder et al., 2020). Although advances in neonatal health and medicine have dramatically improved the survival and well-being of low-birth-weight babies over the years, policy interventions that increase birth weight through better maternal access to healthcare services and nutrition during pregnancy and postnatal periods clearly show several positive effects on children's educational outcomes by improving neonatal health.

Third, positive parenting behaviors are also strongly linked to children's cognitive achievement in the developmental psychology and family demography literatures (Conwell & Doren, 2021; Davis-Kean et al., 2021). Indeed, Bullinger et al. (2022) find that the expansion in public health insurance coverage for low-income parents through the ACA improves children's reading scores, likely through changes in parenting behaviors—such as more time spent reading to children and eating dinner together more often—that are linked to improved children's cognitive achievement. Wehby (2022) also finds similar effects on children's reading outcomes in Iowa when low-income families gained access to Medicaid through the ACA. Similarly, Soni and Morrissey (2022), who study time-use diaries by parents, also find that access to ACA Medicaid expansions change family time use, providing suggestive evidence of the linkages between parental behaviors induced by health policy levers broadly affecting child outcomes.

Finally, the literature evaluating the educational impact of the ACA on college outcomes of young adults is also quite illustrative in this regard. Because the ACA expanded children's coverage on parents' private insurance plans up to age 26, many adolescents gained or retained insurance coverage (Sommers et al., 2013). Several studies explore the impact of the ACA young adult mandate on this population's educational outcomes—specifically, college enrollment.[6] In all, the evidence is quite mixed. Although some studies find small (3%–5%) increases in college enrollment (Jung & Shrestha, 2018; Lopoo et al., 2018; Yaskewich, 2015), including among army veterans (Kofoed & Frasier, 2019), more recent studies using extensive tax-return data find

largely null effects (Heim et al., 2018). Heterogenous effects across various subgroups of young adults exposed to this policy change are also documented. Studies show that the benefits of college enrollment might be limited to women (Lopoo et al., 2018) and those attending 2-year for-profit institutions (Chakrabarti & Pinkovskiy, 2019).

Comparisons With Effective Education Policies

To put this article's quantitative estimates in context, in this section we present comparisons to well-established, causal effects of direct educational policy initiatives. We limit our comparisons here to health and education policy impacts on math and ELA test scores, primarily. Specifically, we first short-list a set of common educational policy interventions that have been extensively studied using QEDs or RCTs.[7] Second, we ensure that effect size estimates on standardized math and ELA test scores of interest are available for the included studies. If multiple studies and replications of the same policy interventions are available, we rely on meta-analytical estimates from recent reviews and/or provide a range of estimates.

It is important to note that we provide these comparisons not to ask or answer questions, such as "Is health insurance access provision better than a class-size reduction intervention to improve test scores?" To answer such questions, a multidimensional evaluation of interventions based on efficacy, cost-effectiveness, and scalability is needed (Kraft, 2020). Nevertheless, we believe that such a comparison, which provides benchmarks of standardized effect size estimates on comparable outcomes from key education policy initiatives, helps contextualize the effectiveness of health policy interventions.

For ease of exposition, we group the interventions and effect sizes across our main health policy interventions into categories that emerged from our systematic review—public health insurance policies; preventive healthcare policies, such as immunizations; nutrition policies inside and outside schools; environmental health improvement policies; behavioral/mental health programs/policies; school-based health policies; direct improvements to family economic well-being; and public health programs, such as nurse home visits. Notwithstanding some overlap across the various groups, we believe that the above categorization helps in the interpretation of results. We also believe that this comparison enhances our conceptual framework when it comes to understanding the potential health policy spillovers on child and adolescent education outcomes.

We include four rigorously evaluated education policy reforms—class-size reductions, per-pupil spending increases, teacher value-added improvements, and individual tutoring reforms—to provide a comparative perspective here. First, one of the most reliable effect size estimates of an educational policy initiative on test scores comes from multiple, rigorous evaluations of class-size reduction policies. Across studies, a reduction of class size from roughly 22 to 15 students is estimated to result in a 0.2 SD improvement in student test scores in math and ELA. Because teachers are one of the core inputs in the education production function, the impact of teacher-quality improvements on student test scores is also evaluated in multiple studies using various quasi-experimental methods. On average, an improvement of about 1 SD in teacher quality (measured using value-added models)[8] improves student test scores by 0.07–0.16 SD in math and 0.02–0.12 SD in ELA (see Gershenson [2021] for a review). Similarly, best estimates of the effect of an exogenous $1,000 increase in per-pupil spending annually over 4 years for school-age children on student test scores, collated from recent research using rigorous policy evaluations, is about 0.04 SD (Jackson & Mackevicius, 2021). Finally, an educational intervention with one of the largest reported effect sizes of 0.23 SD pertains to the benefits of individualized tutoring (Guryan et al., 2021). Also, see recent summaries of tutoring interventions in elementary and middle schools that also provide suggestive evidence of their positive impact (JPAL Evidence Review, 2020).

The heterogeneity in effect sizes of educational interventions on test scores across grade levels is worth noting, however. For example, the median (across results from rigorous interventions) effect size on math (ELA) test scores ranges from 0.04–0.09 SD (0.03–0.08 SD) across students in Grades 4–12 (Kraft, 2020). Most of our health policy interventions focus on elementary and middle school students as well,[9] which makes this range of effect sizes a good benchmark for contextualization.

First, as is apparent from Table 1, the effects of health policy interventions tend to be smaller in terms of absolute magnitudes. Not surprisingly, initiatives primarily designed to promote health may have a smaller impact on education. Nevertheless, it is also clear that the spillover effects of health policy interventions on educational outcomes are far from negligible. Further, it is also important to note that these reported effect sizes are all akin to intent-to-treat estimates that are not adjusted for compliance or treatment uptake and, therefore, will be smaller in magnitude.

Second, direct education policy interventions, such as good-quality teachers and/or per-pupil spending increases, seem to be more effective in improving student math performance as compared to performance in ELA. On the other hand, we observe an opposite trend when it comes to health policy interventions, which are more effective in improving students' ELA performance. This trend appears to be in line with the hypothesis that interventions targeting family processes seem to have larger effects on reading skills, while school-related interventions tend to affect math skills more significantly (Jacob, 2005). Third, environmental mitigation policies in early childhood seem particularly efficacious for student performance in math and ELA.

TABLE 1
Contextualization of Effect Sizes

Health policies and programs					
Policy/ Program	*Standardized effect size on math*	*Standardized effect size on ELA*	*Effects on other outcomes*	*Education level*	*Study(ies)*
Public health insurance	Largely null effect	0.04–0.09	Modest positive effects of 10 pp increase in average Medicaid eligibility on high school dropout (–0.3 pp), college enrollment (0.3 pp), and college graduation (0.7 pp); imprecise effects on math when different from null	Elementary school, high school, and college	Bullinger et al. (2022); Cohodes et al. (2016); Levine & Schazenbach (2009); Wehby (2022)
Preventive health policies, such as immunizations	Very limited evidence	Very limited evidence	Modest decreases in absenteeism (0.6 day per year)	Elementary school, middle school	Plaspohl et al. (2014)
Nutritional policies inside schools	0.02–0.06	Largely null effect	Mixed evidence on obesity rates; small effects on on-time grade promotion; imprecisely estimated null effects on test scores and attendance, especially when short-run effects are examined; small, reductions in school disciplinary outcomes, such as suspension/expulsion	Elementary school, middle school	Ruffini (2022); see Hecht et al. (2020) for a good overview of CEP on health outcomes of children
Nutritional policies outside schools	Largely null effect	0.02	Reduced suspensions/expulsions and grade repetitions	Elementary school, middle school	Chorniy et al. (2020); Cotti et al. (2018); Gassman-Pines & Bellows (2018); Gennetian et al. (2016)
School-based healthcare policies	Largely null effect	Largely null effect	Reduced teenage fertility rates	Elementary school, middle school	Lovenheim et al. (2016)
Environmental health improvement policies/ programs	0.02–0.11	0.07–0.15	Reduced crime rates in the long run	Elementary school, middle school	Aizer et al. (2018); Billings & Schnepel (2018); Sorensen et al. (2019); Stafford (2015)
Special education placement	Limited evidence	Limited evidence	Placement in special education seems somewhat beneficial on test scores; limiting placement in special education seems harmful for graduation and postsecondary outcomes	Elementary school, middle school	Ballis & Heath (2021); Schwartz et al. (2021)
Nurse-family home visits	0.15–0.22	0.08–0.24	Largely null effects for girls	Early childhood	See Heckman et al. (2017) for a summary
Education policies					
Policy /Intervention	*Standardized effect size on math*	*Standardized effect size on ELA*	*Effects on other outcomes*	*Education level*	*Study(ies)*
Class-size reduction from 22 to 15	0.2	0.2	Small, positive effects on long-run outcomes, such as earnings	Elementary school, middle school	Chetty et al. (2011)
Teacher value-added increase of 1 SD	0.07–0.16	0.02–0.12	Many positive effects on long-run outcomes, such as earnings and employment	Elementary school, middle school	See Gershenson (2021) for review
Per-pupil spending increase of $1,000	0.04	0.04	Positive effects on high school graduation and college enrollment	Elementary school, middle school	See Jackson & Mackevicius (2021) for review
Individualized tutoring	0.23–0.37	0.23–0.37	Short-run effects on math and ELA scores in elementary schools largely insignificant	Elementary school, middle school	See JPAL Evidence Review (2020) for review

Note. CEP = Community Eligibility Provision; ELA = English/language arts; pp = percentage points; SD = standard deviation.

Finally, it is important to note the simplification in reporting of effect sizes in Table 1. Wherever possible, if multiple studies were conducted, we report the range of observed effects. Furthermore, if systematic review or meta-analyses were conducted, we cite and note those review studies here. Indeed, there is considerable variation in effect sizes estimated by studies within each education policy category. For example, recent reviews of teacher value-added effects (Gershenson, 2021) and school-spending impacts (Jackson & Mackevicius, 2021) highlight the variation and distribution of effect sizes within each category. Nevertheless, the average effect size summary included in Table 1 provides a good starting point for comparisons.

It is, however, crucial to note that naïve comparisons of effect sizes across initiatives likely provide an incomplete picture; they need to be adjusted for differences in "sample characteristics, analytical approaches, costs, and scalability" to more accurately examine whether these effect sizes are also practically meaningful (Kraft, 2020, p. 249). Carrying out all the appropriate adjustments for every health policy intervention we include in this review is beyond the scope of this article. However, recent welfare analyses of health insurance expansions to pregnant women (per child) clearly illustrate the cost-benefit calculus. Benefit to government is valued at roughly three times the cost of the program—$4,033 per birth to the individual stemming from cost-savings from reduced child hospitalizations and higher taxes paid by children (Hendren & Sprung-Keyser, 2020)—which translates to overall benefits to citizens valued at about 20 times the cost (Currie, 2020). Essentially, a holistic look at cross-domain spillover effects of public programs that target children—especially those that target children from low-income households either directly or through their parents—makes the return on such public investments quite large.

Despite such promise, cross-national research shows that U.S. spending on households with children lags behind that of most other rich countries (Gornick & Smeeding, 2018). Although universal education policy through high-quality, well-funded public schools for all children has long been a worthy goal that we must continue to pursue, education policy researchers (and policymakers) should also look outside schools to enhance equity and mitigate the social disparities in health and education that often go hand in hand. Finally, health policy interventions—especially broad-based access to healthcare through health insurance or other asset-based cash transfer programs (e.g., Temporary Assistance for Needy Families, child tax credits)—are often as (if not more easily) scalable than high-quality universal education across schools (including preschools) in the United States. Improving public spending on education across schools and compensatory funding, especially in districts that serve large numbers of racial/ethnic minority children and children from low-income households, still needs to be actively pursued. However, the key scalability advantage of broad-based public health interventions must also be kept in mind to enhance children's overall well-being, particularly given that educational disparities across sociodemographic subgroups seem to emerge prior to school entry.

Limitations

Our review is not without its limitations. First, given the broad scope of our review, we prioritize breadth over depth. We only provide a broad overview of the core findings instead of delving deeper to critique and discuss each study's findings. Because we include clear inclusion/exclusion criteria regarding the sample size, research design used, and publication in well-respected peer-reviewed journals and working-paper series, we believe that the studies we review are broadly well executed. However, we recognize that this prioritization of breadth over depth in our review as an important limitation. We encourage future research reviews to dive deeper into classes of policies/programs that we identify in our review and provide in-depth critiques of their quality and rigor.

Second, despite our efforts to document objective criteria for inclusion/exclusion in our systematic search process, we had to make some subjective assessments of what counted as a health policy/program and what counted as a well-executed, causal research design that warrants inclusion in our systematic review. The use of a systematic search review process and documentation of inclusion/exclusion criteria, including the PRISMA flow and others, help alleviate some of these concerns; however, we acknowledge the associated limitations of the subjectivity involved as well. Relatedly, our review does not include qualitative research as well as descriptive studies, which could shed light on important mechanisms that might be at play—a limitation we want to acknowledge as well. We encourage more integrative reviews that can highlight/generate hypotheses that can subsequently be tested using RCTs and QEDs.

Policy Implications: Open Questions for Charting a Research Agenda

Can We Expand the Use of Integrated Administrative Health and Education Databases?

A significant barrier to exploring potential spillovers across policy initiatives (especially across health and education domains) in an empirically rigorous way is the lack of integrated administrative databases. First, although several large nationally representative surveys include health and educational outcomes, they still lack sufficient statistical power needed to estimate precise causal effects. Second, although health policy researchers often do not use educational databases or surveys (e.g., Early Childhood Longitudinal Study - Kindergarten (ECLS-K) or the Common Core of Data (CCD)), education policy researchers also do not frequently

incorporate larger national health surveys (such as the National Health Interview Survey or National Survey of Child Health) in their analysis. Furthermore, some of these surveys only allow restricted-use data access for use of geographic identifiers through Census Research Data Centers or non-networked data labs. These barriers preclude cross-disciplinary analyses. Finally, more funding to collect high-intensive (e.g., daily diary, ecological momentary assessments) data with repeated measures of food security and or mental health from larger, generalizable, student samples should also be prioritized.

In contrast, analyses of population registry data from Scandinavian countries that essentially follow entire birth cohorts of children across their life course are invaluable in this regard. Some states in the United States (e.g., North Carolina, Florida, and Washington) make concerted efforts to provide such data linkages; however, the majority of states lag. To illustrate the power of such integrated databases, we discuss findings from two studies included in this review—both use matched birth records with subsequent school records across all students and in-state schools for multiple birth cohorts in Florida—and highlight the mechanisms explored in them. Because many of these studies use within-family variations to control for common, environmental factors, the statistical power afforded by large statewide databases becomes essential for estimating precise effects and for exploring plausible causal mechanisms. For instance, Persico et al. (2020) use such linked data from Florida to examine the effects of cleaning up superfund sites on children's academic achievement. Similarly, Wehby (2022) uses linked birth records and education data to examine the effect of Medicaid access among low-income parents on their children's reading outcomes in Iowa.

Similarly, other mechanisms hypothesized in the epidemiological literature connecting health and education can be tested more effectively by studies using the large sample sizes afforded by education-health data linkages. For example, do health policies and programs that target asthma diagnosis/treatment reduce absenteeism? Additional funding for researchers to conduct larger school-based studies that collect education and health outcome data (including mental health, food insecurity, and others) from large student samples is also needed. Further, larger sample sizes can also help identify children/adolescents most likely to benefit from certain policies or programs. Such studies can thus further sharpen our understanding of the key linkages between health and subsequent human development.

Given the huge variation in outcomes (health and education) across states driven in large part by differences across states' policies and politics (Montez et al., 2020), we also need more states to invest in and share statewide longitudinal databases with researchers and professional educational research organizations—a key priority that has been recently identified by several funding agencies, such as the Institute of Education Sciences: Statewide Longitudinal Data Systems Grant Program (n. d.). The creation of the "cradle-to-career" system by California is an example of an excellent statewide, longitudinal data system, which plans to connect data on early education, K–12 schools, colleges, social/health services, and employment. We hope that such linked data sets will be opened up to researchers and policymakers (State of California, n.d.). States like Minnesota (Center for Advanced Studies in Child Welfare, n.d.) and Wisconsin (Institute for Research on Poverty—UW-Madison, n.d.) have also invested in these types of administrative data linkages, especially between child welfare and education data systems; however, only a small number of affiliated researchers have access to such data riches. Increased uptake of such statewide data linkages as well as widespread data-sharing protocols to democratize secure data access can help us ensure that insights are generalizable across the country.

Can We Dig Deeper Into the Exploratory Causal Mechanisms Underpinning Health Policy and Program Levers?

We encourage scholars to further examine exploratory mechanisms identified by our framework—changes in physical/mental health as well as family economic resources and family functioning processes induced by policy levers—in health and education policy analyses. For example, earlier, we described how Bullinger et al. (2022) explore how parents benefiting from the ACA Medicaid expansions spent more time reading and engaging in consistent family routines with their children, making it a likely mechanism through which positive educational effects emerged. There is emerging evidence that reductions in psychological distress (McMorrow et al., 2017) and increases in mental bandwidth due to fewer worries about money and reduced health-related financial risk among low-income families (Glied et al., 2020; Lombardi et al., 2022) are likely key mechanisms underpinning these changes in family functioning processes. On the other hand, there is also much less evidence of low-income parents working less and or avoiding switching jobs due to loss of health insurance (Lombardi et al., 2022). Future research should pay more close attention to examining such exploratory mechanisms to enhance our understanding of how policies induce changes.

Conclusion

Our systematic review of evidence underscores the overlap between health and human development, especially education. The central role that public policies aimed at improving children's and adolescents' health play in also improving educational attainment and achievement is recognized by social scientists. Yet we are just beginning to unpack the various causal mechanisms and channels through which the education-health gradient operates in the United

States. Recent health policy/program evaluations provide us with an opportunity to synthesize and reflect on these potential mechanisms in our review. In summary, our review makes three core contributions.

First, we develop a conceptual framework mapping the various direct and indirect channels through which health policies and programs affect children's and adolescents' educational outcomes by using a systematic review of the literature. Second, by organizing the emerging evidence on the educational impact of health policy/programs through that framework, we are better able to compare, contrast, and contextualize the observed effects with established education policy interventions. Third, we highlight the evidence (or lack thereof) of some of the underlying health-education mechanisms. For example, the limited evidence on the educational effects of policies/programs designed to improve mental/behavioral health among children and adolescents points us to key gaps in the literature that future research should help plug.

Finally, in reflecting on the evidence from our systematic review, we identify a series of open questions that we believe should be answered to fill the identified gaps in the literature. We hope that these questions can guide the development of a research agenda at the intersection of health and education that holistically investigates health and human development across the life course. Specifically, we highlight the need to increase funding and resources to create and share linked administrative data sets that span the health and education domains to ensure that a research agenda at the nexus of health and education can flourish.

In all, our review highlights the need for education policymakers and researchers to explore the educational effects of policies/programs often implemented outside schools. Simultaneously, health policy researchers should also be encouraged to widen their perspectives and collaborate with schools, districts, and states to examine health policy/program effects on educational outcomes. Such efforts can help disentangle the mechanisms underlying the social determinants of health and education. We encourage the continued inclusion and exploration of educational and health outcomes in data and policy analyses to mitigate disparities across intertwined social systems. Such an integrative look at health and education might reveal innovative, cost-effective policies/programs at the nexus of education and health. Indeed, health policies, if implemented effectively and thoughtfully, could thus very well be effective education policies.

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ORCID iD

Maithreyi Gopalan https://orcid.org/0000-0002-1013-0672

Notes

1. In economics, *spillover effects* are broadly defined as the effects of a policy/activity that have spread further to other groups of individuals (or geographies) than was originally intended or targeted by a policy/activity.

2. QEDs are a class of research designs that can be used to evaluate plausibly causal effects from observational data. Primarily, they involve the inclusion of comparison groups that are not exposed to the policy/program to examine the effect of a policy/program on the "treated" groups. See Gopalan et al. (2020) for an overview of QEDs used in education.

3. In the online appendix, we describe our systematic literature search process for this review in more detail, including the database and journal selection process, search terms, and specific inclusion/exclusion criteria.

4. Because special education programs are implemented at the local school level based on state- and federal-policy guidelines, we only include those studies that evaluate the effect of exogenous changes in access to special education programs for students with disabilities here. Also, not all studies report the effects by disability type, such as physical disabilities, learning disabilities, and/or emotional/behavioral disabilities. Instead, we describe just the main effects across all students who received special education programs, unless otherwise specified.

5. Using variation in ambient seasonal pollen measures across schools within districts during the standardized testing time periods as a proxy for exposure to air pollution, Marcotte (2017) finds causal negative effects on students' math (4.5%–7%) and ELA (2.5%–4.5%) performance in elementary schools. Using richer data examining year-to-year, within-student variation in exposure to pollution stemming from proximity to highways, Heissel and colleagues (2022) find that a decrease in pollution of 10% per day over the school year could be linked to a 0.016 SD increase in test score performance in middle schools. They also find effects on absences (0.54 percentage point [pp] increase), behavioral incidents (4.10 pp increase), and more pronounced test score effects for non-free/reduced-lunch price students, non-Hispanic White students, and Hispanic students. We provide these estimates just to fix magnitudes of effects; however, we do not include these studies in our review, as they do not include a policy/program lever. Similarly, studies conducted outside the United States/Canada are also referenced just for a benchmark here.

6. Because these effects likely emerge due to better economic well-being (i.e., due to adolescents' ability to stay on their parent's health insurance and/or reductions in the need to be tied to jobs for employer-sponsored health insurance) rather than their own health, we discuss these effects in this section of "indirect channels."

7. We do not use a systematic search process to identify the education policy initiatives under consideration here for comparison but apply fairly similar standards for study selection and inclusion based on our background knowledge. Indeed, the What Works Clearinghouse website provides no results when the program delivery type of "policy" is selected, indicating that systematic reviews of evidence from widespread educational policy evaluations are not readily available. Therefore, we rely on our background subject

knowledge to short-list and collate comparable effect sizes in this section. We include all primary citations of these studies to enable future comparisons.

8. Economists use value-added models to assess the effectiveness of educational inputs, such as teachers, schools, and others. These models aim to capture the growth in academic achievement (mostly test scores) over a time period, which can be attributed to specific inputs—such as teachers—after accounting for baseline differences in student achievement and other selection issues (see Gershenson [2021] for a systematic review on teacher value-added effects).

9. With the exception of studies that analyze the impact of health insurance expansions on the college enrollment of dependent children age 26 under the ACA, all the health policy interventions we identify in our systematic review pertain to K–12 students.

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Authors

MAITHREYI GOPALAN is an assistant professor of education and public policy at The Pennsylvania State University. She is interested in conducting policy-relevant, interdisciplinary research that explores the causes and consequences of racial and socioeconomic disparities in student outcomes, using experimental and quasi-experimental research methods.

ROHITHA EDARA is a doctoral candidate at The Pennsylvania State University. She is interested in studying issues at the intersection of education policy, inequalities/segregation, and international development.