



Evans School Policy Analysis and Research (EPAR)

Human Capital and Economic Growth

David Coomes, Elan Ebeling, Terry Fletcher,
Nina Forbes, Namrata Kolla, Rebecca Walcott

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C. Leigh Anderson

Professor C. Leigh Anderson, Principal Investigator

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Introduction

Much literature discusses the importance of investing in human capital—or “the sum of a population’s health, skills, knowledge, experience, and habits” (World Bank, 2018, p. 42)—to a country’s economic growth. For example, the World Bank reports a “chronic underinvestment” in health and education in Nigeria, noting that investing in human capital has the potential to significantly contribute to economic growth, poverty reduction, and societal well-being (World Bank, 2018). This research brief reports on the evidence linking investment in human capital—specifically, health and education—with changes in economic growth. It reviews the literature for five topic areas: Education, Infectious Diseases, Nutrition, Primary Health Care, and Child and Maternal Health. This review gives priority focus to the countries of Bangladesh, Burkina Faso, Democratic Republic of Congo, Ethiopia, India, Kenya, Madagascar, Nigeria, Rwanda, and Tanzania. For each topic area, we report the evidence in support of a pathway from investing in human capital to economic growth.

Methods

We reviewed literature in five topic areas: Education, Infectious Diseases, Nutrition, Primary Health Care, and Child and Maternal Health. The latter four topics fall under the broader topic of Health. See Appendix B for sample search strings we applied in each topic area as part of this review.

We conducted all searches in the Scopus database, which includes articles from peer-reviewed journals only, books, conference proceedings, and patents. To be considered for review for inclusion in the Scopus database, a journal must meet four criteria including: 1) peer-reviewed content; 2) be published on a regular basis and have a registered ISSN number; 3) references in Roman script and English language abstract and titles; and 4) have a publicly available ethics information. All journals eligible for review are evaluated against five criteria including journal policy, content, journal standing, publishing regularity, and online availability (Elsevier, 2019).

We began by limiting our search to 2010 or later, but if literature was sparse in a specific topic area, we included publications from farther back. We restricted our review to experimental and quasi-experimental studies, systematic reviews, and cost analyses. For a description of these methodologies, see Appendix B.

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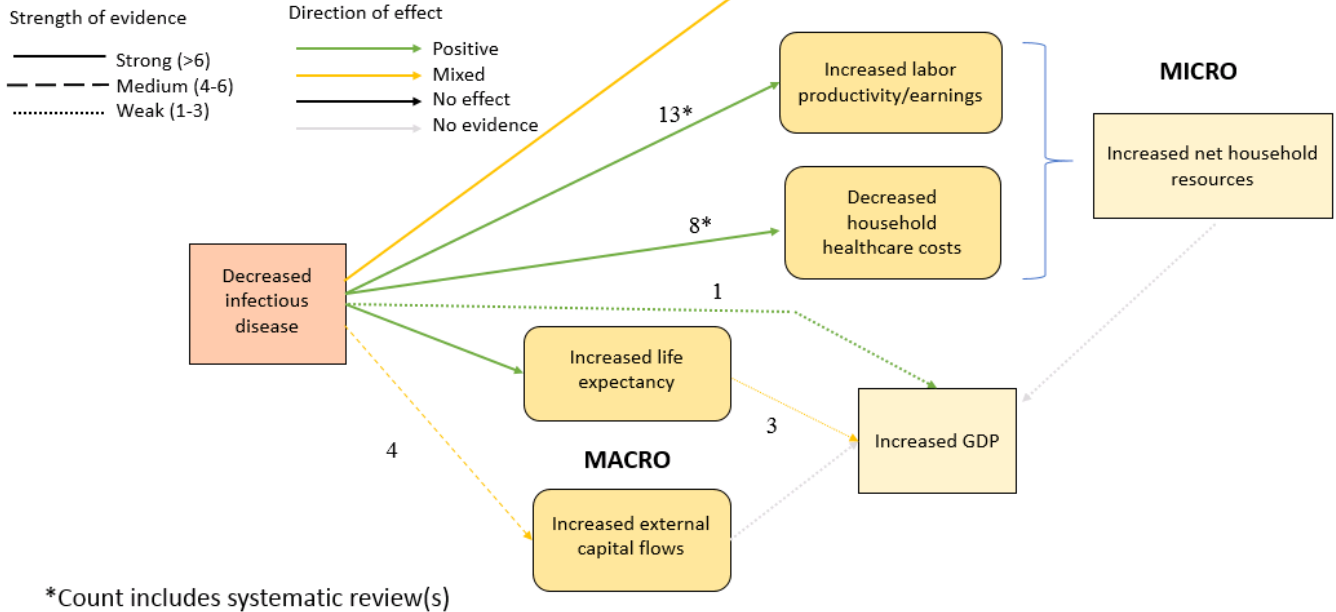
Please direct comments or questions about this research to Principal Investigator Leigh Anderson at eparinfo@uw.edu.

Infectious Disease

Figure 1. Infectious Disease Pathways

INFECTIOUS DISEASE

Peer reviewed studies found by pathway since 2009



Literature review

Searches for empirical evidence linking infectious disease burden to educational attainment and to household resources were conducted in Scopus and Google Scholar. Searches were focused on studies conducted in the last ten years; however, studies contained within systematic reviews may include earlier time periods. Cost analyses made up the majority of studies linking disease burden to household resources, and many included both intermediate pathways of reduced labor productivity and increased healthcare spending. All studies mentioned below are listed with full references in the attached spreadsheet titled “Review of Human Capital and Economic Growth Results Coding”.

Searches for empirical evidence linking infectious disease burden to macro-level economic growth were conducted in Scopus and Google Scholar. Backward and forward reference searching was also conducted for the limited number of articles found.

Decreased disease -> Increased educational attainment (for children)

Limited evidence (2 studies) for target countries. One study found mixed evidence of increased educational attainment for women in India after the nationwide eradication program in the 1950s (Cutler, et al., 2010). A study in Tanzania found improvements in literacy resulting from decreased malaria prevalence (Klejnstrup, et al., 2018). The spreadsheet also includes a highly-cited study linking malaria eradication to increased educational attainment and literacy in Paraguay and Sri Lanka (Lucas, 2010), as well as a study revealing a similar linkage in Uganda (Barofsky, et al., 2015).

The link between helminth infection and cognition/educational attainment is well-studied in the target countries. A systematic review of 45 studies (from the Cochrane Database) describes the evidence of the link between deworming and cognitive improvement to be “very low quality” and the link between deworming and increased school attendance to be “very low quality”. The evidence that deworming has no effect on cognitive function is described as “moderate” (Taylor-Robinson, et al., 2015). One study (Kenya) found evidence linking childhood deworming to increased adult labor productivity (Baird, et al., 2016).

Decreased disease -> Increased HH resources (decreased healthcare costs and increased labor productivity)

A systematic review of 49 studies (16 of which take place in target countries) regarding the economic burden of tuberculosis on households reveal this link to be well-studied (Tanimura, et al., 2014). There is consensus that tuberculosis decreases household resources through both increased healthcare costs and through reduced labor productivity; however, the extent to which household resources are affected ranges widely.

Likewise, four studies consistently identify a link between malaria and household resources, including pathways through healthcare costs and/or labor productivity. A highly-cited study of malaria eradication in the Americas establishes a link between malaria eradication and increased income (Bleakley, 2010), but a study in India finds limited evidence of this link for men only (Cutler, et al., 2010).

There are limited household cost analyses describing the economic burden of HIV/AIDS in the target countries: one in Nigeria categorizes healthcare expenditures (Etiaba, et al., 2016) and one in Ethiopia reveals reduced labor productivity (Zegeye, et al., 2018). A propensity-score matching study in Ethiopia links HIV/AIDS to reduced household resources through both increased healthcare expenditures and reduced labor productivity (Kibret, 2018), but a quasi-experimental study in Kenya and Uganda finds that reduced labor productivity is contingent on high CD4 counts (Jakubowski, et al, 2018).

Evidence is limited on the effect of childhood infectious disease and caregiver productivity. Search strings identified two studies on the link between childhood diarrheal disease and the adult caregiver’s reduced labor productivity (Bangladesh and Kenya).

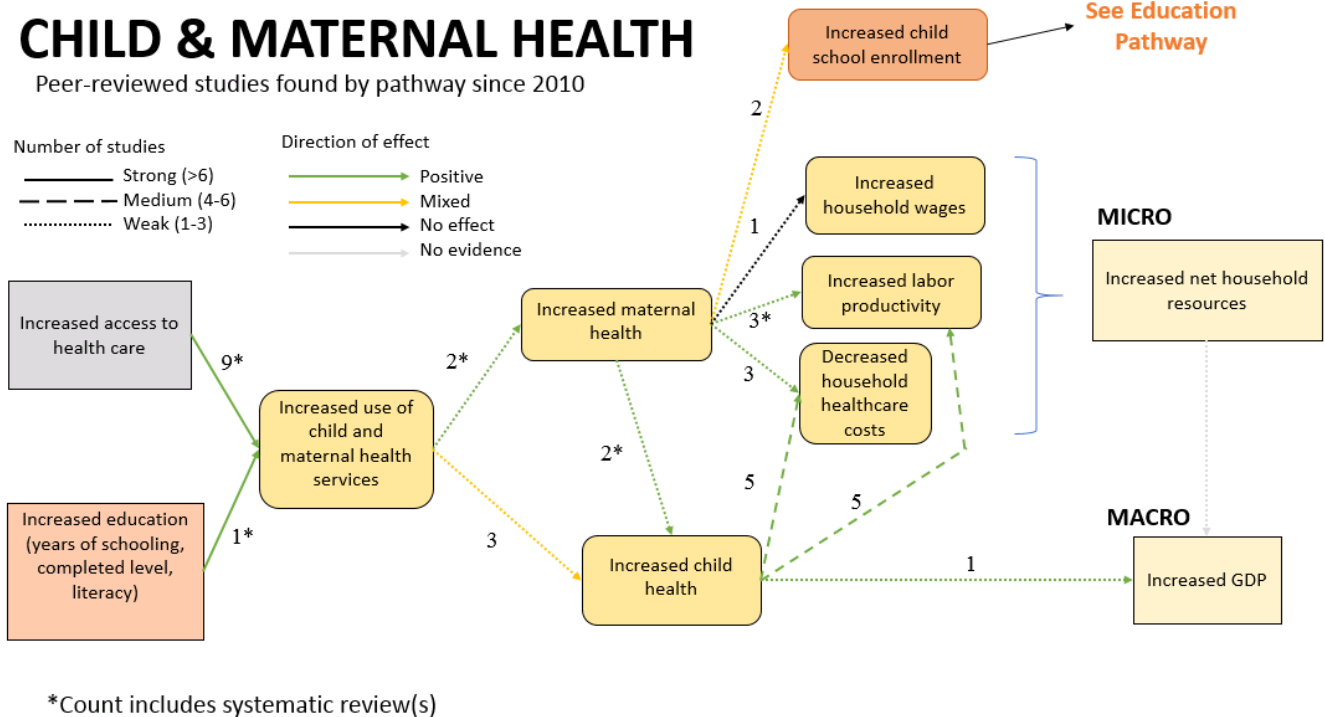
Decreased disease -> Increased GDP

The theoretical links between population health and economic growth are numerous, but the empirical evidence is limited. Rigorous analysis at the macro level is methodologically difficult, due to the large number of potential confounders to attribution. Increases in life expectancy due to disease reduction have been shown to have mixed effects on GDP, as the increase in population growth that results from increased survival may negatively impact GDP per capita. However, one study using an econometric model demonstrated that increases in vaccination rates over time led to sustained increases in GDP (Masia, et al., 2018).

There is limited evidence on the effect of infectious disease prevalence on external capital flows. Three studies demonstrate that prevalence of infectious disease (HIV/AIDS, tuberculosis, and malaria) may reduce foreign direct investment. One study modeled the effect of expected disease risk on tourism revenue, predicting a substantial increase in revenue for India if malaria were eradicated.

Child & Maternal Health

Figure 2. Child & Maternal Health Pathways



Literature review

Searches for empirical evidence linking child and maternal health to household resources were conducted in Scopus. Searches were focused on articles published from 2010-2019. Apart from a systematic review, cost analyses made up the majority of studies linking disease burden to household resources, and many included both intermediate pathways of reduced labor productivity and increased healthcare spending. Searches for empirical evidence linking infectious disease burden to macro-level economic growth were conducted in Scopus. Searches were focused on articles published from 2010-2019.

Decreased disease -> Increased HH resources (decreased healthcare costs and increased labor productivity)

We found medium evidence linking childhood health to net household resources and robust evidence linking maternal health to net household resources. Overall, we identified 10 studies linking decreased child and maternal health to decreased household resources through increased health care costs and labor productivity losses.

Six studies including five cost analyses report that increased child disease (diarrheal diseases, pneumonia, and meningitis) leads to both increased household health care expenditures and lost productivity in the form of foregone caregiver earnings.

A systematic review of 124 studies (Onarheim et al., 2016) finds that increased maternal illness and complications from pregnancy and delivery lead to decreased labor productivity. The authors report that the effect of health on labor market productivity is especially strongly associated with increased women's nutritional health. Additionally, a quasi-experimental study from Bangladesh finds that increased maternal

illness leads to a small reduction in days worked but that the reduction in household resources was almost entirely driven by increased health care costs.

The evidence on the link between maternal health and wages is limited—we identified one study that reports no impact of maternal illness on wages.

Decreased disease -> Increased GDP

The empirical evidence linking decreased child and maternal disease to increased GDP is limited. While there are numerous cost-of-illness studies that estimate the social cost of maternal ailments such as obstetric complications, these are based off of projections. Rigorous analysis at the macro level is methodologically difficult, due to the large number of potential confounders to attribution.

One study (Klobodu et al., 2018) uses time series data to analyze the effect of child and maternal health on GDP in six sub-Saharan African countries. The authors find that a decreased infant mortality rate led to an increase in GDP capita across all study countries (Burkina Faso, Togo, Ghana, Ivory Coast, Botswana, and South Africa), and that the effect of infant mortality rate on GDP was greater than the reverse relationship. Additionally, the study finds that the positive impact of life expectancy at birth for females on GDP per capita is higher than the reverse relationship for LMIC (Ghana, Ivory Coast, Botswana and South Africa) while the positive impact of life expectancy at birth for females on increased GDP per capital is lower than the reverse relationship for LIC countries (Burkina Faso, Togo).

Additional Pathways

The following pathways arose from studies that surfaced when searching for the two main pathways above; however, because our search strings did not directly target these linkages, the studies found to support these pathways may only be part of the evidence base.

Increased financial access to healthcare->Increased use of child and maternal health services

Increased educational attainment->Increased use of child and maternal health services

The drivers influencing the use of child and maternal health services (especially factors leading to facility-based delivery) have been well-studied. Eight studies including a systematic review of 160 studies (Kyei-Nimakoh et al., 2017) report a positive effect of increasing financial access to healthcare through health insurance enrollment, user fee removal, or voucher programs, on facility-based delivery. One study in Burkina Faso found only short-term positive effects of a fee subsidy policy on facility-based deliveries, and an additional study in Kenya found that a user fee removal policy had no effect on facility-based deliveries.

The relationship between educational attainment and use of child and maternal health services is also well-researched. A systematic review includes 17 studies that find a positive effect of increased maternal education on decreased maternal mortality through increased knowledge and use of contraceptives, antenatal and postnatal care, and facility-based delivery (Yakubu, Y., Mohamed, N., and Abidin, E., 2018).

Increased use of child and maternal health services->Increased maternal health / Increased child health

Although we identified only a small number of articles linking increased use of child and maternal health services to increased child and maternal health, our search strings were not directly targeting these pathways. Therefore, these relationships merit further research to gain a better picture of the full evidence base.

Increased maternal health->Increased child health

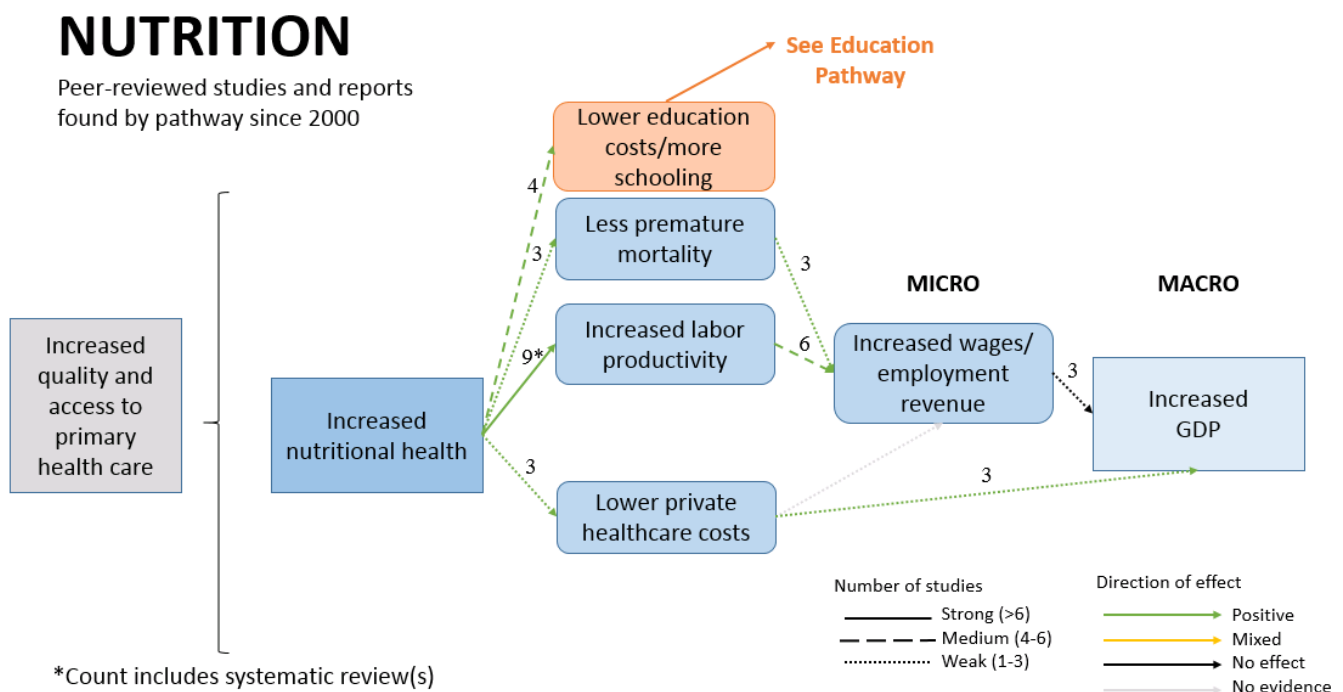
Onarheim et al.'s (2016) systematic review finds that increased maternal mortality is linked with increased child mortality. Additionally, a 25-year longitudinal study in Ethiopia found that infants faced a much higher mortality risk if their mother died within 42 days of giving birth.

Increased maternal health->Increased child educational enrollment

We found limited and mixed evidence linking increased maternal health to increased child educational enrollment. However, as our search strings did not directly target this link or the link between increased child health to increased educational attainment, this relationship merits further research.

Nutrition

Figure 3. Nutrition Pathways



Literature review

Searches for empirical evidence linking nutritional health to labor productivity and GDP were conducted in Scopus. Searches were focused on studies conducted in the last ten years, but four studies spanned earlier time periods (but post-2000). Quasi-experimental studies made up the majority of studies linking nutrition to labor productivity and wages, whereas time series and cost analyses made up the majority of studies linking nutrition to GDP and other macro-level outcomes.

The vast majority of studies focused on low-income and rural populations, though very few were conducted in target countries. The target country primarily studied is India, which was the site of 6 studies. Some of the other countries studied were Ethiopia, Guatemala, Ecuador, and China.

Increased nutrition -> Lower education costs / more schooling

There is medium evidence for increased nutritional health leading to lower education costs or more schooling (4). Education is also hypothesized to be correlated with wages and GDP, and this connectivity between nutrition, education, and wages is often cited across studies. All four studies for this pathway show positive effects and were conducted in multiple countries including Chile, Ecuador, and India. The Indian study, for example, measured the cognitive abilities of children in the age range of 5 to 10 years attending a corporation school in the City of Bangalore and found that children in the malnourished group performed significantly worse in tests of attention, comprehension, learning, and memory compared to children in the adequately nourished group.

Increased nutrition -> Less premature mortality -> increased wages -> increased GDP

There is weak evidence that increased nutrition reduces premature mortality and increases GDP (3). All three studies are cost analyses where the economic burden of morbidity is calculated retrospectively and generally includes an assessment of how much labor that person would have conducted had they survived.

Increased nutrition -> Increased labor productivity -> increased wages

There is strong evidence that improving nutrition will improve labor productivity (9). An area that has been heavily studied in the literature is the “productivity nutrition trap” where workers at particularly low levels of nutrition are incapable of working, which lowers their productivity, lowers their wages, lowers their purchasing power, and ultimately cycles back to lowering their nutrition (Jha et al, 2008). A similar theory that has strong evidence is the nutrition-based efficiency wage hypothesis which states that at low income levels, there is a relationship between nutrition and labor productivity (Weinberger, 2004).

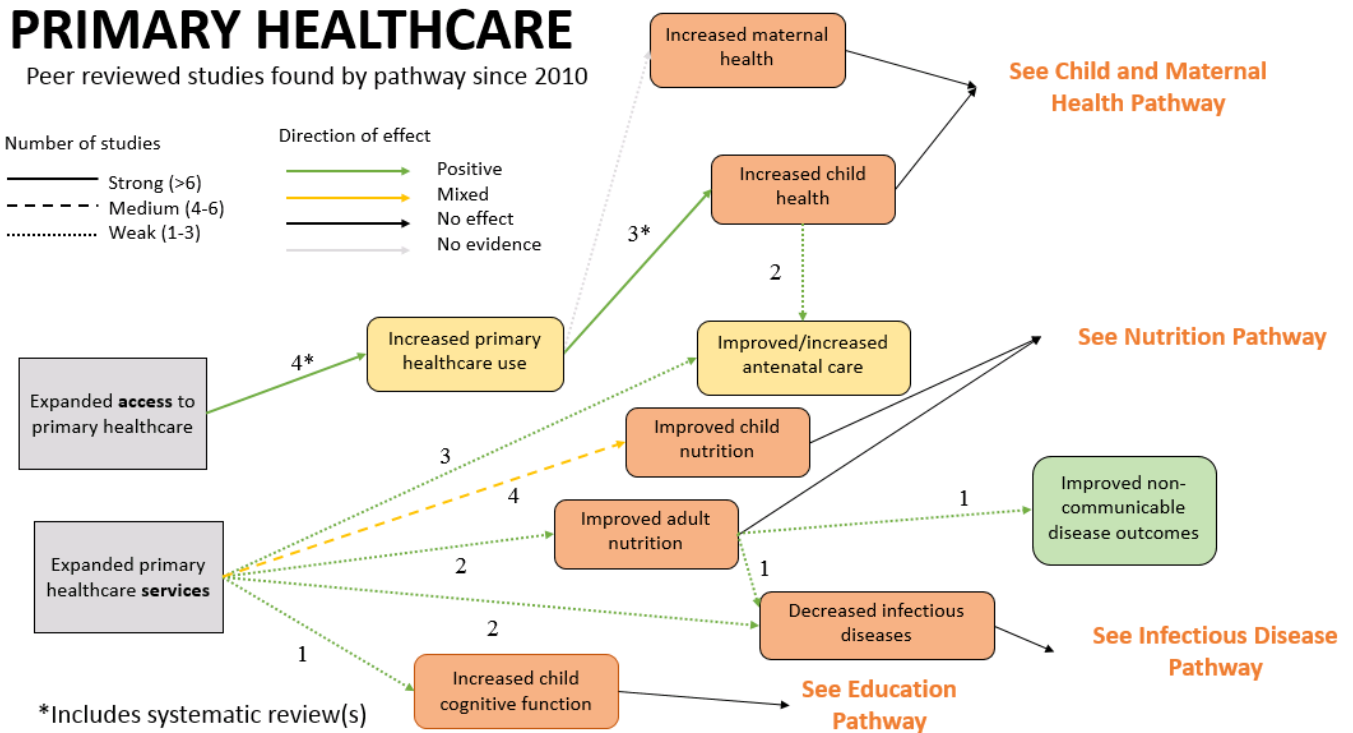
In one of the nine studies supporting this pathway, specifically the systematic review, there is indirect evidence that the size and growth of an infant (proxies for nutrition) is associated with income and wealth, mediated through adult size. There is no association with BMI-for-age and income as an adult. However, the other eight studies all show positive association between nutrition, labor productivity, and wage gain. Common measures of nutrition were micronutrients (e.g. calcium, vitamin A, iron), caloric intakes, and weight-for-height measures. Common measures of outputs were hours worked, farm output, and wages.

Increased nutrition -> Lower healthcare costs -> Increased GDP

There is weak evidence that increasing nutrition lowers private and public healthcare costs, which ultimately increases GDP (3). All three studies were cost analyses that assumed lower healthcare costs are a lower burden for public healthcare systems and ultimately increase GDP. Two studies were conducted in Central and South America while one study was conducted for Egypt, Ethiopia, Swaziland, and Uganda.

Primary Healthcare

Figure 4. Primary Healthcare Pathways



Literature review

Searches for empirical evidence linking primary healthcare to household resources and increases in GDP were conducted in Scopus. Searches were limited to articles published between 2010-2019. No studies were found that report a link between primary care and household resources or GDP directly. All sources included report a link between primary care and intermediate health outcomes that are associated with household resources in other pathways. Included in this analysis are three systematic reviews, seven experimental studies, and five quasi-experimental studies.

There is not a single agreed upon definition of primary healthcare within the health literature or distinction between primary care and primary health care. **Primary health care** often refers to an overall health systems strategy outlined by the WHO at the Alma Ata conference of 1978 which focuses on universal access to health care as well as health as a tool for economic and social development. **Primary care** refers to a specific element that is often included within primary health care. This is clinical service delivery of preventive and curative medicine as a first contact with the health system. This is different from secondary or tertiary care in that primary care is designed to treat multiple health needs of a community while the others are disease or illness specific. In this review we take primary healthcare to mean primary care rather than primary health care. For more background on primary care and primary health care see Rao, 2014; Muldoon, 2006; and Markuns, 2013.

Expanded access to primary healthcare -> increased primary healthcare use -> reduced morbidity and mortality

Four sources, including two systematic reviews, link expanded access to primary healthcare with increased primary healthcare use or improved health outcomes. The evidence that expanded access to primary healthcare is associated with reduced child morbidity and mortality is relatively robust, however, we uncovered little research on maternal or other health outcomes. Among the target countries, one review notes that community-based primary health care programs in Bangladesh and India have resulted in reduced child mortality (Perry, 2017). Another review examines the impact of Brazil's Family Health Strategy (FHS) with outcomes that are related to primary health care. This review finds that while there is no evidence that FHS impacts vaccination rates or birth weight, there is robust evidence that FHS was associated with lower child mortality (Bastos, 2017). The review included 14 studies that examined child mortality, 13 of which reported lower child mortality associated with primary healthcare.

Expanded primary healthcare services -> improved morbidity and mortality

The specific services included in primary healthcare differ from context to context, and much of the research dedicated to primary healthcare investigates the outcome of including additional services within the basic package of primary healthcare. The strongest evidence among the studies that we reviewed included that related to increased or improved antenatal care and the impacts on child health. Three quasi-experimental studies report that increasing access to antenatal care within primary healthcare, either through midwives, traditional birth attendants, or community health workers is associated with increased uptake in antenatal care services or reduced child mortality. Similar to the studies that examined expanded access to primary healthcare, these studies did not report on the association of expanded services with maternal mortality.

Six studies reported an impact of including nutrition interventions within primary healthcare on nutrition related outcomes, all of which were cluster randomized control trial designs. Of these studies, four examine child nutrition while the other two examine adult nutrition. Three of these studies took place in target countries (India, Bangladesh, and Burkina Faso), while the other three studies took place in Brazil. Overall, the evidence on the impact of these interventions is mixed. Among the studies that show positive impacts, one reports that an intervention including nutrition education and supplementation in India among women living with HIV/AIDS (WLH/A) resulted in improved HIV outcomes (Nyamathi, 2018). A study carried out in Burkina Faso assessing primary healthcare-based maternal nutrition counseling found increased birthweight among babies born to women in the program but no change in child growth or morbidity compared to the control group (Nikièma, 2017). Additionally, one study examines the impact of a nutrition intervention on reducing heart disease-related biomarkers in adult patients with hypertension. This pathway suggests the possibility that nutrition-related interventions in primary healthcare may be used to treat non-communicable diseases as well.

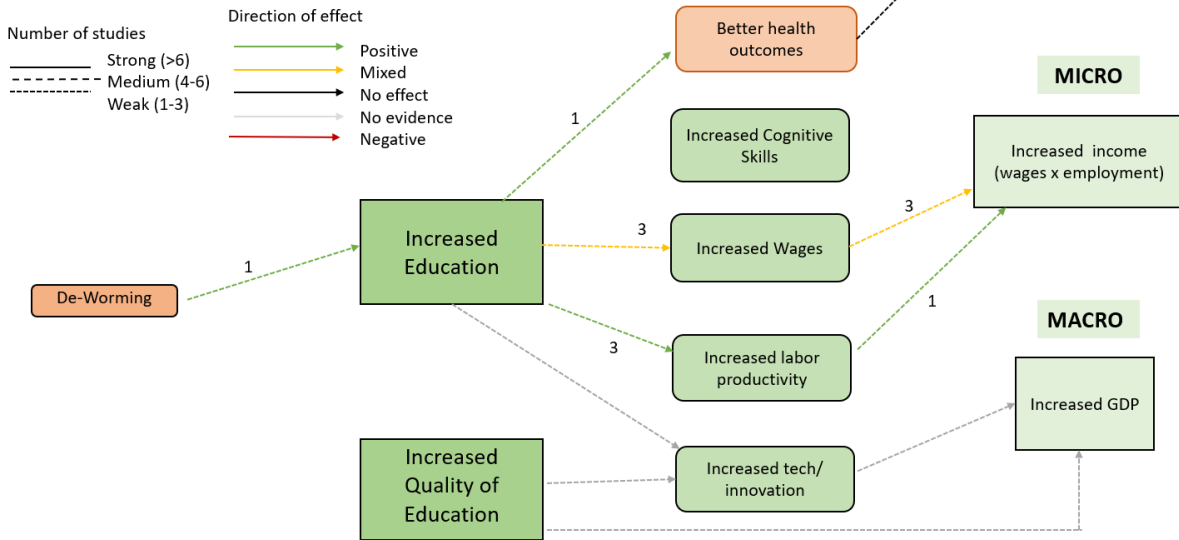
One study reports on the impact of a primary healthcare-based child development program for underweight children in Bangladesh using a cluster-randomized controlled trial. This study reports an improvement in child cognition, language, and motor composite scores among children in the experimental group although it reports no significant effect on child growth (Hamadani, 2019).

Education

Figure 5. Primary Education Pathways

PRIMARY EDUCATION

Peer-reviewed studies found by pathway since 2009

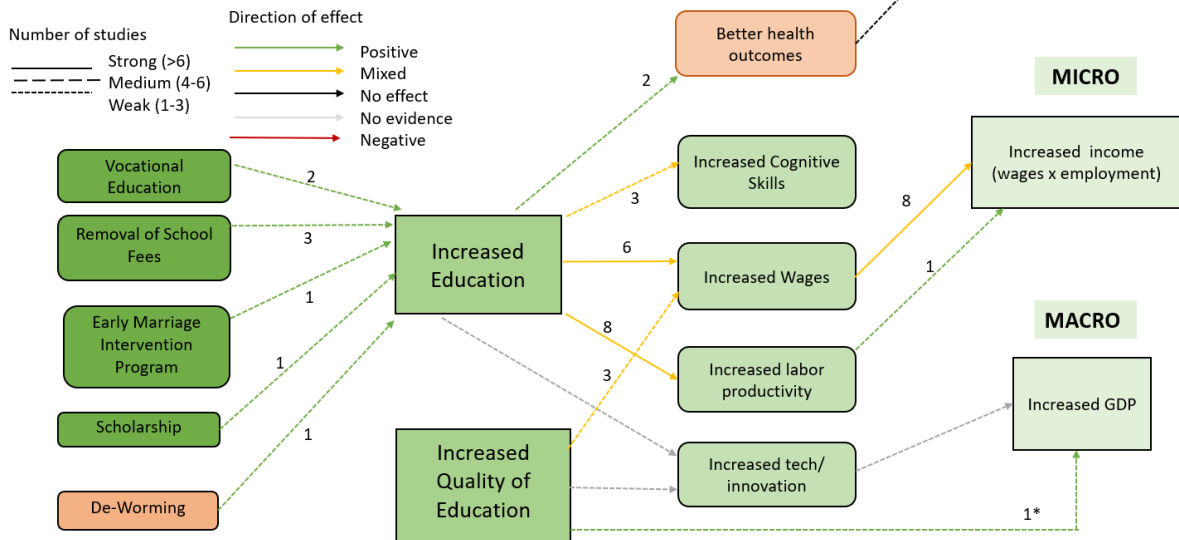


*Systematic review

Figure 6. Secondary Education Pathways

SECONDARY EDUCATION

Peer-reviewed studies found by pathway since 2009



*Systematic review

Literature review

Searches for empirical evidence linking increased quality or quantity of educational attainment to increased income as well as macro level economic growth were conducted in Scopus. Searches were focused on studies conducted in the last ten years; however, studies contained within systematic reviews may span further time periods.

Quasi-experimental methods made up 19 of the studies linking educational attainment or quality to income. One experimental study linked increased education to higher wages. 11 articles disaggregated schooling results by gender, usually highlighting the impacts for girls specifically.

Several studies mentioned mechanisms that preceded increased secondary education, including: two on vocational education, three on removal of school fees, one on early marriage intervention programs, one on scholarships, and one on de-worming treatments.

Increased educational attainment->increased cognitive skills->higher wages-> increased income

Three studies discussed cognitive skills in relation to increased secondary education, but did not make the next connection to increased income. The results of increased cognitive skills were mixed, with one study finding positive results and two finding no measurable effect. One study theorized that this had to do with the decline in school quality after a push to make school more widely available.

Nine studies connected increased schooling and wages (three for primary schooling and six for secondary schooling), but results were mixed. Two studies linked increased secondary education with a decrease in wages, both were in reference to women, and theorized that limitations women face in the job market was the likely cause. Three studies made a positive link between increased primary education and wages. A more common focus was on increased labor productivity, which showed up in eight studies on secondary education and one separate study on primary education. While results were also mixed, the positive connection was much stronger with seven of those studies showing positive associations between increased education and labor productivity.

Two studies highlighted additional vocational training as a way to increase secondary schooling achievement, and connected it to increased wages and increased labor productivity. This may have had less to do with the additional years of schooling than the nature of the skills being taught in vocational training being more aligned to the needs of the labor market. Interestingly, for one of those studies only women were more likely to get higher wages as a result of vocational training, while men got lower wages or did not have any significant wage effects.

Increased quality of schooling often appeared as an outcome variable, rather than an input, potentially because there is a lack of consensus around what constitutes a high quality school. Three studies did link increased quality of secondary education to wages, but the results were mixed.

Increased Schooling-> Increased GDP

One systematic review associated increased educational attainment to increased GDP per capita. The studies that made connections to increased labor productivity did so at a micro level. None of the studies referenced increased technological innovation/ creation as an outcome variable.

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Appendix A. Review Coding Framework

- **Document Information**
 - Document number
 - Database
 - Search string
 - Author(s)
 - Title
 - Publication Journal
 - Link
 - Year
- **Geography**
 - Priority country (Bangladesh, Burkina Faso, Democratic Republic of Congo, Ethiopia, India, Kenya, Madagascar, Nigeria, Rwanda, Tanzania)
 - Other countries
- **Sector & Pathway**
 - Sector (health, education)
 - Primary health? (Y/N)
 - Health sector (infectious diseases, child and maternal health, nutrition, primary health care)
 - Broad pathway
 - Detailed pathway
- **Methodology & Effects**
 - Methodology (experimental, quasi-experimental, or cost analysis)
 - Describe
 - Positive effect? (Y/N, N= no effect, negative, or mixed)
 - Effect size (from abstract only)
 - Systematic review? (Y/N)
 - Included studies, start (year)
 - Included studies, end (year)
- **Education Articles Characteristics**
 - Primary or secondary education
 - Gender disaggregated? (coded for education only)

Appendix B. Sample Search Strings & Included Methodologies

Table 1. Sample search strings

Search string	# of articles pulled for review
Education	
((("school* attainment" OR "education* attainment") AND (bangladesh OR "Burkina Faso" OR drc OR "Democratic Republic of Congo" OR ethiopia OR nigeria OR rwanda OR tanzania OR kenya OR india OR madagascar) AND experiment* AND ("economic growth" OR gdp OR wage* OR productiv* OR earning* OR income*)))	6
((("primary education" OR "primary school*") AND (Bangladesh OR "Burkina Faso" OR DRC OR "Democratic Republic of Congo" OR Ethiopia OR Nigeria OR Rwanda OR Tanzania OR Kenya OR India OR Madagascar) AND experiment* AND ("economic growth" OR GDP OR wage* OR productiv* OR earning* OR income*)))	8
((("secondary education" OR "secondary school*") AND (Bangladesh OR "Burkina Faso" OR DRC OR "Democratic Republic of Congo" OR Ethiopia OR Nigeria OR Rwanda OR Tanzania OR Kenya OR India OR Madagascar) AND experiment* AND ("economic growth" OR GDP OR wage* OR productiv* OR earning* OR income*)))	9
Primary Health Care	
("primary health*" OR "primary health care") AND (experiment* OR impact) AND ("economic growth" OR GDP OR wage* OR productiv* OR earning* OR income* OR "maternal child health" OR "nutrition" OR "infectious disease")	20
Nutrition	
(("nutrition") AND ("increase employment" OR "labor prod*" OR "absent*" OR "economic growth" OR "GDP"))	2
Infectious Diseases	
TITLE-ABS-KEY(("economic burden" OR "care cost*" OR earn* OR "productivity loss*") AND hiv AND (bangladesh OR "Burkina Faso" OR drc OR "Democratic Republic of Congo" OR ethiopia OR nigeria OR rwanda OR tanzania OR kenya OR india OR madagascar))	5
Child and Maternal Health	
"maternal illness" AND (India OR Bangladesh OR Ethiopia OR madagascar OR nigeria OR tanzania OR rwanda OR "democratic republic of congo" OR "burkina faso" OR Kenya) AND ("economic" OR "economic growth" OR GDP OR earning* OR income* OR "labor productiv*" OR "productiv* losses")	6

Table 2. Methodologies included in literature review

Methodology	Description
Experimental	Experimental studies use randomized assignment of a control and experimental group to measure the causal effect of an intervention (e.g. the effect of integrating an infant feeding training program into primary care on infant feeding practices). Experimental studies are considered the most rigorous empirical evidence for causation.
Quasi-experimental	<p>Quasi-experiments are empirical studies used to estimate causal effects without using random assignment of treatment or control groups. We used the following guidelines to define quasi-experimental designs.</p> <p>We considered a study to be quasi-experimental if it mentioned any of these methods:</p> <ul style="list-style-type: none"> ○ Instrumental variables (IV) <ul style="list-style-type: none"> ▪ Two-stage least squares ○ Regression Discontinuity ○ Difference-in-differences ○ Synthetic control ○ Propensity score matching ○ Causal inference <p>OR if the study used panel data and mentioned any one of the above methods or one of the below:</p> <ul style="list-style-type: none"> ○ Fixed effects ○ Random effects ○ Logit or Logistic Regression ○ Probit Regression ○ Conditional Logit ○ Alternative-Specific Conditional Logit ○ Ordered Logit/Probit ○ Count Models or Poisson
Systematic review	Systematic reviews collect and summarize all empirical evidence relating to a research question. Studies included in systematic reviews are chosen for inclusion based on evaluation against pre-defined criteria (e.g. study methodology, study design, time period, etc.).
Cost analysis	Cost analyses are used to estimate the economic burden of morbidity on households. Data are typically collected retrospectively through household surveys of affected individuals. Cost analyses generally include an assessment of direct medical costs (e.g., healthcare expenditures), direct non-medical costs (e.g., transportation to and from health facilities), and indirect costs (e.g., lost income due to days of work missed attributable to illness).