Adolescents in a changing world

The case for urgent investment

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Foreword

Today's adolescents,1.3 billion strong, are more than one-sixth of the global population. Growing up in a world that is churning with historic transformations – political, social, economic and environmental – they have both deep concerns and high expectations for themselves and their societies.

As global leaders and advocates for human rights, we rally behind and stand with adolescents, in all their diversity. To develop and thrive, adolescents need support, investment, and opportunities. This landmark report makes a critical, social and economic case for countries and communities to invest in the well-being of adolescents and girls in particular. For countries, investing in adolescent well-being is not just a moral imperative, it's a strategic investment in resilient communities and sustainable development.

UNFPA, UNICEF and WHO are committed to listening to, and meaningfully engaging with, adolescents, and to advocating for the acceleration of sustainable investments in them and in their well-being. From ensuring their education and skills training to supporting access to quality health information and comprehensive services, including for sexual and reproductive health, to promoting mental health support and fostering safe and secure environments, we are dedicated to equipping adolescents with the knowledge, tools and resources they need to navigate the complexities of adolescence and live up to their potential with confidence and resilience.

Working together with adolescents, youth and allies, we are determined to forge a brighter future where every young person has the opportunity to realize their potential, contribute meaningfully to their communities and advance a more equitable and sustainable future for all.

Dr Tedros Adhanom Ghebreyesus	***Dr Natalia Kanem***	***Catherine Russell***
WHO Director-General	*Executive Director, United Nations Population Fund (UNFPA)*	*Executive Director, UNICEF*

Preface

As we reach the halfway mark of the SDGs, the global landscape has been marred by unprecedented challenges. Among the most affected demographics are adolescents. Despite these adversities, adolescents have demonstrated remarkable resilience, emerging as catalysts for positive change, embodying hope, and serving as sources of inspiration for communities worldwide.

Today, adolescents make up more than 16% of the world's population. They are a demographic which is often overlooked or misunderstood. In recent years, there has been more recognition of the unique challenges to well-being confronting adolescents, and of the need to address these in development agendas, but action has been slow.

This report focuses on the imperative of investing holistically in adolescents and their well-being. Such investments can reduce inequalities and help to protect the human rights of adolescents. As is evident throughout the report, the economic and social returns from a wide range of investments to address adolescent well-being are significant.

The report makes a compelling case for investing in adolescents, they are living in a world facing multifaceted crises, and they will be tomorrow's changemakers and leaders. The staggering cost of inaction is estimated at US$110 trillion over a period of 27 years (2024-50). That amounts to 7.7% of the total GDP of those countries included in the models, which themselves include around 80% of the world's population.

The report provides valuable insights into interventions where investments will yield high returns, including those focused on health services and multisectoral interventions, for example on HPV, TB, myopia, education and training, child marriage and road accident prevention. This evidence base is crucial for policymakers, practitioners, researchers, educators, donors, and civil society organizations as we map the road ahead for a better and more sustainable future.

As well, the report is a significant step forward in advocating for adolescent well-being, where adolescents have the support, confidence, and resources to thrive in contexts of secure and healthy relationships, and realizing their full potential and rights. It calls for more prioritisation, increased investment, and immediate action for adolescent well-being.

Finally, investing in adolescents and their well-being strengthens the human capital of a country, and hence a country's potential for future development and for ending extreme poverty and creating more inclusive societies.

As we embark on this journey, we eagerly anticipate the discussions and collaboration this report will catalyse, around creating futures where adolescents are empowered to thrive in a secure and healthy environment and realise their full potential and rights.

Rt Hon Helen Clark	***Dr David Imbago***	***Professor Bruce Rasmussen***
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None of the external writers, reviewers or experts on the Technical Expert Consultative Group declared any conflict of interest.

Acronyms

4Rs	Program on Reading, Writing, Respect and Resolution
AEP	Adolescence Education Programme
BCR	Benefit-cost ratio
CBT	Cognitive behavioural therapy
CCT	Conditional cash transfer
CI	Confidence interval
CL	Cooperative learning
CMBC	Child marriage benefits cost
CTC	Communities that care
CVPP	Cardiff Violence Prevention Programme
DALY	Disability-adjusted life year
DBM	Double burden of malnutrition
FFT	Functional family therapy
FGM	Female genital mutilation
FHF	Fred Hollows Foundation
GBD	Global burden of disease
GDP	Gross domestic product
GNI	Gross national income
HIC	High-income country
HLYG	Healthy life-year gained
HPV	Human papillomavirus
IARC	International Agency for Research on Cancer
IBRD	International Bank for Reconstruction and Development
IHME	Institute for Health Metrics and Evaluation
ILO	International Labor Organization
IPV	Interpersonal violence
LAYS	Learning-adjusted years of schooling
LIC	Low-income country
LLMIC	Low- and lower middle-income country
LMIC	Lower middle-income country
LST	Life skills training
MDR-TB	Multidrug resistant tuberculosis
MIC	Middle-income country
MST	Multi-systemic therapy
NCD	Noncommunicable disease
NPV	Net present value
OBPP	Olweus Bullying Prevention Program
ODA	Official development assistance
OECD	Organisation for Economic Cooperation and Development

OHT	OneHealth Tool
PATHS	Promoting Alternative Thinking Strategies
PDFY	Preparing for the Drug Free Years
PHC	Primary health care
PLH	Parenting for Lifelong Health
QALY	Quality-adjusted life year
RCT	Randomized controlled trial
RMNCH	Reproductive, maternal, newborn and child health
ROI	Return on investment
SDGs	Sustainable Development Goals
SEHER	Strengthening Evidence base on scHool-based intErventions for pRomoting adolescent health
SEL	Social and emotional learning
SEYLE	Saving and Empowering Young Lives in Europe
SFP 10–14	Strengthening Families Program for Parents and Youth, 10–14 years
SMD	Standard mean difference
SRH	Sexual and reproductive health
STH	Soil-transmitted helminth
TB	Tuberculosis
Triple P	Positive Parenting Program
UHC	Universal health coverage
UIS	UNESCO Institute of Statistics
UMHIC	Upper middle- and high-income country
UMIC	Upper middle-income country
UN H6+	PMNCH, UNAIDS, UNESCO, UNFPA, UNICEF, UN Major Group on Children and Youth, UN Women, World Bank, World Food Programme, WHO
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations Children's Fund
UNFPA	United Nations Population Fund
VEM	VISES Education Model
VISES	Victoria Institute of Strategic Economic Studies
VSL	Value of a statistical life
WASH	Water, sanitation and hygiene
WHO	World Health Organization
YAM	Youth Aware of Mental Health

Executive summary

Today's adolescents (defined here as persons aged 10–19 years) face serious challenges in a rapidly shifting world. These range from the effect of population changes and age distribution, the impact of climate change on mental health and well-being, the learning crisis and the persistent inequality, violence and neglect of human rights experienced, especially by women.

The world urgently needs a new investment programme to improve the well-being of adolescents. The cost of inaction is too high. This investment must cover all five domains of adolescent well-being: health, connectedness, safety, learning and employability, and agency and resilience, and the linkages between them. Investment must underpin a global programme carried out at the local level with initiatives tailored to the realities of individual countries and involving the young people themselves, allowing them to express their specific needs.

Transformative investment in three key platforms or systems is necessary: universal health coverage (UHC), including primary health care (PHC); enhanced schools that focus on learning, health, nutrition and student well-being; and support systems based in local communities. These platforms are not only key points for programme delivery but are essential to ensuring that all adolescents are covered and that the complex linkages involved are fully realized.

The purpose of this report is to present the case for this much-needed investment in supporting adolescent well-being across the globe. By investment we mean a planned programme of spending on interventions known to be effective in increasing adolescent well-being in all its facets. To this end, an extensive review of the literature focused on intervention evaluations has been conducted and new modelling work has been completed.

As is evident throughout this report, the economic and social returns from a wide range of investments to address adolescent well-being are high. Such investments will reduce inequalities and help to protect the human rights of adolescents. They have never been more timely, given the current state of the global demographic and epidemiological transitions and the fact that there is now a substantial body of evidence that shows selected interventions for this age group can be highly effective. Finally, investing in adolescents and their well-being strengthens the human capital of a country, and hence the country's potential for future development and for ending extreme poverty and creating more inclusive societies.

With many affected countries already highly indebted, large-scale support from the international community will be necessary for these investments to be undertaken on the required scale. At the same time, locally tailored interventions taking account of specific needs and local knowledge and expertise about effective programmes will be crucial.

The modelling presented in this report was for interventions introduced and progressively scaled up over the period 2024 to 2035. Where the interventions were extended in time, they were held at the 2035 level through to 2050. The key quantitative measure used for the investment case is the benefit-cost ratio (BCR). This is the ratio of the value of benefits to the cost of the investments necessary to achieve those benefits. For a wide range of investments analysed here, the BCRs are 10 or above, with much higher values in many cases. An investment in which the benefits are 10 times the cost is a very strong one indeed.

It is not possible to estimate BCRs for some areas (for example, connectedness, agency and interpersonal violence [IPV]) because the underlying empirical work is not available. This does not deny their importance to adolescent well-being but rather challenges researchers to strengthen their knowledge. The coverage of the BCR results within this report reflects the availability of studies in the literature.

Within the need for an extensive programme of investment to build the universal platforms, based on BCR studies and other evidence assembled here, we identified six priority areas:

- malnutrition: hunger and undernutrition, micronutrient deficiencies and overweight/obesity;

- mental health: both prevention and treatment;

- learning, skills and employment;

- the position of women, including reductions in child marriage and in unplanned pregnancies;

- the prevention of violence and injury; and

- the preparation of adolescents to cope with emerging realities.

Although a return of at least US$ 10 dollars for every US$ 1 spent is excellent, the cost of the full suite of investments described here are high. Total costs to span until 2035 are estimated to approach US$ 2.8 trillion, or an average of about US$ 230 billion per annum over the 12-year period of 2024 to 2035 in present value terms. This amounts to about 0.25% of the average projected global gross domestic product (GDP) over the period.

Large-scale and immediate investment to increase the capabilities and well-being of adolescents is now of critical importance. This investment will empower young people to meet the challenges before them and to thrive in the decades ahead. The cost of inaction will be very high. We estimate that the average annual cost of inaction (the benefits foregone) over the period 2024–2050 for areas and countries studied in this report, is US$ 4.1 trillion. This amounts to an average of 7.7% per annum of the projected total GDP of the emerging market and developing economies, over this 27 year period. As this report demonstrates, the returns on these investments – the returns to action – are also high, both in terms of BCRs and in terms of fulfilling human rights and reducing inequalities around the world. The time for action is now.

Cambodia: Disability inclusion in health, 2023 © WHO/Miguel Jeronimo

Cholera outbreak in Sierra Leone, 2012 © WHO/Fid Thompson

1. *Introduction and review – the urgency of action on adolescent well-being*

1.1 Emerging conditions shaping adolescent well-being

Many emerging features of the contemporary world are making the development process more difficult for contemporary adolescents. Below, we summarize eight challenges arising from ongoing processes of global change.

- **Population trends and unplanned pregnancies.** Reflecting very different trends in birth rates, adolescent populations are projected to rise sharply in many countries (for example, by 60% by 2050 in sub-Saharan Africa) but to fall precipitously in others (for example, by 40% by 2050 in China, Republic of Korea and Japan combined). At both extremes, the rate of population change will have major effects on the development process for young people. In many countries, continuing population growth reflects an ongoing high rate of unplanned pregnancies and the continued, if declining, incidence of child marriage.

- **Impact of climate change.** It is now clear that continuing climate change, manifesting both in the growing frequency of dangerous weather events and in projections of future warming, is adversely affecting adolescent mental health in many countries, and the physical conditions for young people in some regions. As the world continues to warm, these effects are likely to become more marked and of deepening concern to younger generations.

- **Learning crisis.** While rates of attendance at school have risen in almost all countries, there is now evidence that the learning achieved by adolescent populations has plateaued and is far from acceptable levels in many countries. Low levels of literacy and numeracy provide a poor base from which to address other emerging challenges.

- **Technological change and employment.** Both economic structures and technologies are undergoing rapid change. Manual and routine jobs are being replaced by new technologies across the board; the service and care sectors are displacing the goods sectors, especially as sources of employment, while emerging artificial intelligence (AI) technologies imply a new era of change. Employment will remain a major challenge for young people, especially for those without a quality education and strong skills development.

- **The double burden of disease.** For some time now, the double burden of disease—a continuing burden of communicable disease combined with a rising incidence of noncommunicable diseases (NCDs)—has been a reality in many countries. As the precursors of future NCDs, such as malnutrition, obesity and poor mental health, continue to rise among adolescents almost everywhere, the double burden of disease will continue to be a problem in low-income countries (LICs).

- **Continuing malnutrition.** Malnutrition, which covers undernutrition, micronutrient deficiencies and obesity, remains a critical challenge for current and emerging adolescent cohorts. Indeed, the double burden of malnutrition (DBM)—the simultaneous manifestation of undernutrition and overweight/obesity—affects most low- and middle-income countries (LICs and MICs). While this report focuses mainly on one response to malnutrition, the various dimensions of malnutrition remain a key challenge for adolescents around the world.

- **Persistent inequality and violence.** Pronounced inequality, both within and across countries, remains a persistent, and in some respects an increasing, reality in the world. Adolescent well-being is strongly related to socioeconomic status, whether within countries or between them. Adolescent well-being is, on average, lower in LICs than in high-income countries (HICs) and, within a country, lower in the lower socioeconomic groups than in higher socioeconomic groups.

- **Increasing migration pressures.** The combination of rapid population growth in many countries and the growing impact of climate change in many regions is likely to increase migration flows in forthcoming decades. This applies to both cross-border and internal migration, and to both distressed or refugee flows and to voluntary migration. Where the skills of the migrants match those of the recipient country or region, both parties are likely to benefit, but this may not be the case for refugees and distressed migrants leaving an unstable situation with limited skills.

1.2 Domains, linkages and platforms

1.2.1 The five domains of adolescent well-being

In planning and developing a case for investment in programmes that aim to improve adolescent well-being, the targets for such programmes must be clear. This relates to the various domains of adolescent well-being and the linkages that exist, if any, between these domains and between the various interventions planned to impact a given domain of well-being.

Recent work by the UN H6+[1] Technical Working Group on Adolescent Health and Well-being (Ross et al., 2020) has clarified the definition and five domains of adolescent well-being (see Fig. 1.1). These are: good health and optimum nutrition; connectedness, positive values and contribution to society; safety and a supportive environment; learning, competence, education, skills and employability; and agency and resilience.

Fig. 1.1 Five domains of adolescent well-being

Each of these domains and their subdomains (see Table 1.1) are important to well-being. Adolescence brings a maturation of all bodily systems and is a phase of sensitivity to the physical, nutritional and social environment. During this phase, the social dimensions of well-being (connectedness, a safe and supportive environment, learning and human capital, and the development of agency and resilience) become especially important. Adolescence is also a phase when risks, including tobacco and alcohol use, physical inactivity, poor diet, and overweight and obesity, increase the probability of contracting NCDs in later life. The interventions must address each of the domains of well-being (Patton et al., 2016).

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1. *UN H6+ is a partnership of the United Nations Population Fund (UNFPA), United Nations Children's Fund (UNICEF), United Nations Women, World Health Organization (WHO), the United Nations Programme on HIV/AIDS (UNAIDS) and the World Bank. PMNCH (Partnership for Maternal, Newborn and Child Health), United Nations Education, Scientific and Cultural Organization (UNESCO), United Nations Major Group on Children and Youth (UNMGCY), and the World Food Programme (WFP) joined the UN H6 on the UN H6+ Technical Working Group on Adolescent Health and Well-being.*

Table 1.1 **The five domains and sub-domains of adolescent well-being**

Good health and optimum nutrition	Connectedness, positive values and contribution to society	Safety and a supportive environment	Learning, competence, education, skills and employability	Agency and resilience
> Physical health and capacities > Mental health and capacities > Optimal nutritional status and diet	> Connectedness > Values > Attitudes > Interpersonal skills > Activity > Change and development	> Safety > Material conditions > Equity > Equality > Non-discrimination > Privacy > Responsive	> Learning > Education > Resources, life skills and competencies > Skills > Employability > Confidence	> Agency > Identity > Purpose > Resilience > Fulfilment

Source: Ross et al. (2020).

These domains of well-being are not separate, independent aspects of adolescent well-being. Many factors influencing adolescent development have interactive effects with one another with a complex interplay between physical and mental health, learning, sexual maturation and the connectedness, safety and supportiveness of the community context in which the adolescent matures. Some of these aspects of health and growth during adolescence affect maternal health during pregnancy, which is a critical factor in providing a healthy start to life. These linkages, both within and across generations, are of critical importance. Given this complex mosaic of influences and interactions, we need an approach to adolescence that is both holistic and multidimensional.

This is especially so for young women who are particularly disadvantaged in many settings. Many factors combine to undermine the well-being of adolescent girls in all too many countries. These include limited education, child marriage, high and early fertility, poor access to health care and fertility control, low status within the family and the community and endemic violence toward women.

The literature increasingly recognizes that if interventions are to be effective in shaping the various domains of well-being in ways that take account of the diverse linkages between them, they need to be situated within strong platforms or systems designed for this purpose. As noted earlier, these platforms or systems are the UHC system, enhanced schools designed to deliver multiple, reinforcing interventions and support systems at the community level.

1.2.2 The UHC system

It is vital that the health system provides UHC to adolescents and that this care is extended to emerging issues for adolescents, such as poor cardiovascular health. This is far from the case in most countries.

With inequality heavily shaping the access that many adolescents have to good quality health care, a commitment to UHC is central to the Sustainable Development Goals (SDGs), with SDG 3.8 requiring the global achievement of UHC with financial risk protection by 2030. This has long been a priority of the World Health Organization (WHO) and extensive literature has outlined the need for UHC, the progress being made towards it and the pivotal role of developing PHC within UHC.

This same literature also makes clear that, in spite of progress, adolescents in many parts of the world, and especially in LICs, do not have access to many key health services. The investment programme of 95 interventions analysed in this report would be a major step forward in providing UHC for adolescents.

1.2.3 The enhanced school platform

The school is a pivotal institution for shaping adolescent development and one that receives extensive funding. Over the past two decades, the surge in the numbers of adolescents in school in most countries has stretched schools and their funding agencies thin so that the quality of learning has often not kept pace.

Additionally, there is now evidence that schools are the best place for delivering other programmes that contribute to adolescent welfare. This includes social and emotional learning (SEL), improved nutrition, deworming and the prevention of anaemia and malaria. Rather than distracting schools from their central educative role, there are good reasons for thinking that such programmes can assist schools in achieving their primary goals of student retention and high-quality educational outcomes.

This approach, and the need for enhanced schools in this sense and for increased investment in them, was strongly endorsed by the 2022 Transforming Education Summit report produced by the UN (2022a). This report also stresses the depth of inequality and disadvantage inherent in current schooling arrangements; globally, 75% of children aged 0–14 years have access to only 8.6% of global public investment in education while the 25% of children living in LICs have access to only 0.6% of this investment. By sharp contrast, the 25% of the world's children aged 0–14 years living in upper-middle and high-income countries (UMHICs) have access to 91% of global investment.

In addressing the severe challenges facing adolescents noted above, the reshaping of schools into powerful, shared platforms to deliver high-quality education in conjunction with better mental and physical health and the promotion of the well-being of learners is a critical task (see Fig. 1.2).

1.2.4 The community platform

The other vital platform is the community development network at the local level, which can be critical to the effective implementation of interventions. Interventions employing these networks often focus on improved parenting and address adolescent delinquency, IPV and harmful substance use, among other problem areas. One such programme is the aptly named Communities that Care (CTC). Studies by Kuklinski et al. (2015) have illustrated the value of these programmes. This is illustrated briefly in section 1.6.4 in relation to the position of women.

Fig. 1.2 *Platforms, linkages and interventions in the investment case modelling*
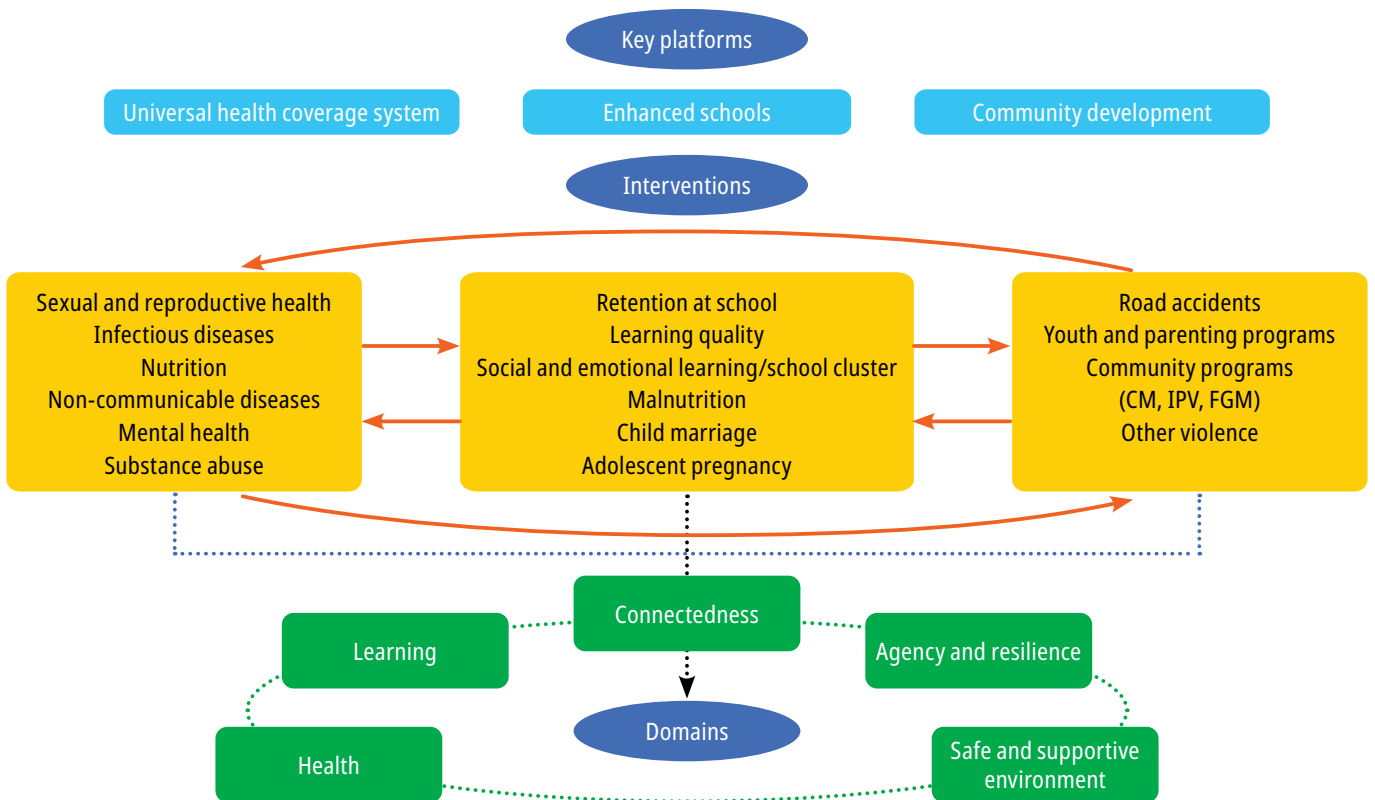
1.3 Costs and benefits of the interventions

In this section, we summarize some of the quantitative results of the study. First, in section 1.3.1, we report our estimates of the costs of inaction to the countries concerned, which are the costs of doing nothing further to address the challenges facing adolescents. Second, in sections 1.4.1 to 1.4.3, we review our findings on the BCRs for a wide range of interventions. The cost-benefit results are derived by updating, or re-estimating, models developed by reserachers within the VISES for earlier studies (see Tables 1.2–1.4) and by a review of the academic literature to identify benefit-cost models relevant to this project (see Tables 1.5–1.6).[2]

1.3.1 The costs of inaction

The cost of inaction is the cost of failing to take action to address the challenges facing adolescents and to improve their well-being. There are several possible approaches to measuring the cost of inaction, but in this report we take a social opportunity cost approach.

In each of the intervention areas noted below, we construct a base case (broadly the consequences of persisting with existing policies and programmes) and an intervention case (broadly a path to achieving socially achievable outcomes by 2035, with the interventions continued at the 2035 level out to 2050). Using epidemiological or other subject-specific models to estimate the human impact of the interventions and an economic model to value those impacts, we derive an estimate of the economic and social benefits of the intervention outcomes relative to those of the base case. The full report describes the process of constructing these cases for each of the areas. The costs of inaction are the economic and social costs incurred by failing to take action to implement the interventions. That is, the costs of inaction are equal to the value of the benefits achieved through the interventions and foregone by inaction.

We have applied this approach to the following areas:

- health (adolescent health services, HPV vaccination, tuberculosis (TB) prevention and treatment and treatment of myopia);
- education and training;
- child marriage; and
- road traffic injuries.

Insufficient information is available to extend this approach to other areas.

The cost of inaction (the benefits foregone) pertains to failing to implement the interventions over the period 2024–2050. They are expressed as net present values (NPVs) at a 3% discount rate (further details are provided in Annex 1). The period of the cost of inaction is defined by the period for which the interventions are not implemented (2024–2050), but some of the benefits foregone will be outside this period, spread over the lifetimes of the individuals involved.

We estimate that the average annual cost of inaction over the period 2024–2050 for these areas and for the countries we study, which vary for different interventions, to be US\$ 4.1 trillion per annum. This amounts to 7.7% of the projected total GDP of these countries over this 27-year period. That is, on average, the costs of inaction are equivalent to 7.7% of total GDP for these countries each year. We use the projected GDP of countries in the World Bank's emerging market and developing economies as a proxy for the GDP of modelled countries. These estimates relate to the number of countries for which the modelling has been undertaken as listed in the tables below and detailed in Annex 1, Table A1.7. For most cases, over 80% of the global population of adolescents live in these countries. For further details of these estimates see Annex 1.

1.3.2 Models and sources for BCR results

In terms of BCRs, we report two types of modelling results in the tables below and in the individual chapters that follow. The first type consists of results arising from eight models developed by the reserachers of the current report (see Annex 1 for further details). In many cases, these models build upon and extend earlier models developed in conjunction with colleagues, especially from UNFPA, WHO and UNICEF in previous studies.

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2. *It follows that the research conducted for this study was based on existing data and other evidence and did not involve any human subjects so no ethics review was required.*

We wish to acknowledge the contributions made by these various co-authors of earlier papers and the role of the agencies, especially UNFPA, which commissioned and, in part, funded these studies. Table 1.2 provides a summary of the development history of these eight models and subsequent chapters of this report provide further details.

There are two other points worth noting about these models. First, they adopt, in several different forms, a broadly human capital approach to valuing the benefits. A central aspect is the potential GDP lost from death, illness or injury and/or the potential GDP gained from improved human capital, with, where relevant, the additional social value lost through death, illness or injury. These estimates are prepared using country and age-specific projections of participation rates and death rates.

Secondly, for multi-country studies, two methods are available for reporting the average ratio of benefits to costs and hence the average BCR. The first is simply to add up the BCRs for each country and divide by the number of countries. The second is to sum up all the estimated benefits separately and then compile the costs for each country and divide the total benefits by the total costs. This gives a much bigger weighting to countries generating larger estimated benefits and costs (for example, those with larger populations such as China and India). We call the BCRs produced by the first method the unweighted average (of the country results) and the second the weighted average, where the weighting of country results is by population. Both of these are reported here.

Table 1.2 *Origins and development paths for eight benefit-cost models used in this report[3]*

Model	Origin and development	Development work for this report
1. Adolescent health services	Built for Sheehan et al. (2017) based on prior work for Stenberg et al. (2014) and reported in Sweeny et al. (2019).	Full re-estimation of OneHealth Tool (OHT) results with updated cost and economic components. See Chapter 2, section 2.1.
2. HPV	While an earlier model was used for Sheehan et al. (2017), a new model is used here.	The new model was built jointly with the Daffodil Centre, University of Sydney and Sweeny, Nguyen et al. (2023). See Chapter 2, section 2.2.
3. TB prevention and treatment	Not previously included in published VISES modelling.	This new model estimates the BCR from implementing the WHO End TB Strategy in 50 countries (95.7% of adolescent TB deaths). See Chapter 2, section 2.3.
4. Myopia screening and treatment	Not previously included in published VISES modelling.	This new model, developed with the support of the Fred Hollows Foundation (FHF), uses inter alia evidence from the Lancet Global Health Commission on Global Eye Health (Burton et al., 2021). See Chapter 2, section 2.4.
5. Education and training	Built for Sheehan et al. (2017) from earlier work by UNESCO and UNICEF; reported in Wils et al. (2019).	The re-developed model retains the basic structure of transition through grades. Upgrades include a new meta-analysis for effect sizes and the grouping of related interventions. See Chapter 6, section 6.2.
6. Improved productivity and employment	Built for Sheehan et al. (2017); reported in Sheehan and Shi (2019).	Modest macroeconomic multiplier and innovation effects have been added, but otherwise the values from the 2019 paper have been used. See Chapter 6, section 6.4 and Table 6.3.
7. Prevention of child marriage	Initial modelling reported in Sheehan et al. (2017) and Rasmussen, Maharaj et al. (2019) with further development in UNFPA (2022).	The model used here now includes 70 countries with updated data inputs and effect size estimates. An optimization facility was also developed to permit the selection of the most effective interventions. See Chapter 7, section 7.2.2.
8. Road traffic injury prevention	Initially developed for Sheehan et al. (2017); see also Symons et al. (2019). Further enhanced since then with support from the FIA Foundation (Symons et al., 2022).	For this project, the model has been substantially upgraded from the latest published version. Changes include a new approach to the baseline and to rural/ urban analysis, updating of effect sizes and better infrastructure modelling. See Chapter 7, section 7.4.

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3. Details of the interventions modelled are provided in the individual chapters of this report, and for health services in the table in the online Annex.

1.3.3 The interventions – costs and benefits

As described in Chapter 2 of this report, we model a wide range of 95 interventions directed at providing universal coverage of adolescent health services. Annex 2 to this report provides more details on the methods used and, in Table A2.2, a full listing of interventions analysed. The modelling is undertaken using the OHT together with an economic model to calculate the economic and social benefits. Chapter 2 also provides details of modelling undertaken with other partners and reported here on HPV vaccination and on programmes to prevent and treat TB and to screen for and treat myopia in adolescents.

Table 1.3 shows that the BCR for a broad range of adolescent health services on an unweighted basis and covering both economic and social benefits is 9.6 and 5.4 on a weighted average basis. This latter result reflects lower BCRs than the unweighted average for several large countries. The BCRs for the smaller three programmes are considerably higher, ranging from 13.0 to 53.6 on an unweighted average basis. These analyses are discussed in Chapter 2. These results suggest that there are high returns to implementing proven, simple and low-cost interventions in well-defined populations.

Table 1.3 *ROI from scale-up of adolescent health services, HPV vaccination, screening and treatment of cervical cancer, prevention and treatment of TB, and screening and treatment of myopia in adolescents*

Status	BCR economic	BCR economic plus social	BCR economic	BCR economic plus social
	Unweighted average	Unweighted average	Weighted average	Weighted average
Adolescent health services				
All countries modelled (40)	6.3	9.6	3.5	5.4
HPV				
All countries modelled (78)	12.7	20.2	10.8	17.8
TB				
All countries modelled (50)	37.9	53.6	39.4	54.4
Myopia in adolescents				
All countries modelled (19)		13.0		21.1

Note: See the description of weighted and unweighted averages in section 1.3.2.

In cost terms, and probably also in terms of linkage to a range of other domains of adolescent well-being, the initiatives for schooling, learning and training are a dominant part of the necessary investments. The analysis of these issues is reported in Chapter 6, including the details of the models used, the specification of the interventions and the estimation of costs.

The BCRs for these education and training investments, covering both economic and social benefits, are high, at 28.6 unweighted and 15.9 weighted (Table 1.4). Table 1.4 shows that these are genuinely transformative investments.

Table 1.4 *ROI from education and training interventions in 64 countries, BCRs*

	Low-income	Lower middle-income	Upper middle-income	Total
Unweighted average				
Total	33.0	17.5	34.6	**28.6**
Weighted average				
Both	27.6	16.4	33.8	**15.9**

Note: See the description of weighted and unweighted averages in section 1.3.2.

Table 1.5 provides a summary of studies from the recent literature and from our own new modelling for this project, covering a wide range of areas discussed in Chapters 3, 4 and 5, namely aspects of connectedness, agency and resilience; mental health; and school feeding as one response to malnutrition. As discussed in these chapters, modelling of many of these issues is difficult and highly complex with few multi-programme analyses published in the literature. Within the available studies, we highlight the paper by Stelmach et al. (2022), which finds a BCR of 23.6 for a wide range of interventions to improve mental health in 36 countries, and the Verguet et al. (2020) study of school meals augmented with health measures in 14 countries, finding a central case BCR of 17.0.

Table 1.5 *Summary of BCRs for mental health, parenting, health and behavioural problem prevention, school climate and school feeding interventions*

Author	Location	Interventions	Benefits	BCR
Multi-programme studies				
Stelmach et al. (2022)	36 countries across all income groupings	Wide-ranging mental health interventions (teacher-led SEL-type, cognitive behavioural therapy (group and internet-based)	Comprehensive (mental health, education outcomes and productivity)	23.6
Verguet et al. (2020)	14 countries in Latin America, South Asia and Sub-Saharan Africa	School meals with treatment for worms and supplements to prevent anaemia	Reduced STH and anaemia cases; improved learning outcomes and wages	17.0 (range 7–35)
Single programme studies				
Belfield et al. (2015)	United States of America	SEL (life skills, 4Rs, socioemotional training)	Reduced depression and bullying and improved education outcomes	3.5–13.9
Nystrand et al. (2020)	Sweden	Positive parenting and parenting competence	Improved adolescent behaviours	10.6
Spoth et al. (2002)	Mid-west United States of America	Parenting programme	Reduced harmful substance use	9.6, 5.9
Kuklinski et al. (2015)	United States of America	CTC programme	Reduced harmful substance use, delinquency and violence (short-term)	8.2
Kuklinski et al. (2021)	24 communities in various states in the United States of America	CTC provides resources to activate communities	Reduced adolescent substance use, delinquency, and related problems (long-term)	12.9
This report	Bihar, India	School climate and connectedness	Reduced depression and bullying and improved education outcomes	25.6

Notes: 4Rs is the Program on Reading, Writing, Respect and Resolution; CBT is cognitive behavioural therapy; CTC is Communities that Care; SEL is social and emotional learning; STH is soil-transmitted helminths.

Table 1.6 provides a summary of BCRs for interventions to protect adolescents from various types of violence and injury, such as child marriage, aggression, suicide and road traffic injuries. Here we highlight two studies completed by the VISES team specifically for this study, both elaborated on in Chapter 7. One is modelling of a package of education and community initiatives to reduce child marriage in 70 countries, which generates a weighted BCR of 25.9. The other is detailed modelling of interventions to reduce road accident fatalities and serious injuries in 77 countries, which produces a weighted BCR of 9.1.

Table 1.6 **Summary of BCRs for interventions to reduce violence and injuries in adolescents**

Author	Location	Interventions	Benefits	BCR
Chapter 7 of this report	70 countries	Education and community programmes	Reduce child marriage	25.9
WSIPP (2023)	United States of America	PATHS: curriculum promoting emotional and social competencies	Reduces aggression and improves ability to resolve conflicts	24.4
Stelmach et al. (2022)	36 countries	Hospital and school-based suicide prevention programme	Reduce suicide	62 (hospital) 3.5 (school)
Chapter 7 of this report	77 countries	Broad-based programmes: infrastructure, alcohol, speed and helmets	Reducing road fatalities and serious injuries	9.1

1.4 Limitations of the economic and social modelling

1.4.1 Variations in applicability across the domains

The UN H6+ domain framework (Ross et al., 2020) outlined in Table 1.1 provides a comprehensive structure in which to address most aspects of adolescent well-being.

Some of the domains lend themselves to the type of investment case evaluations employed in this report, some less so. Domains 1 and 4 encompass health and education, which are the major focus areas of public investment and, for that matter, a good deal of private investment in adolescent well-being. Accordingly, the important features of the health and education systems have received significant academic and other research attention, facilitating the development of evaluation models designed to test the ROI in these domains, such as those described in this report (Sheehan et al., 2017; Stenberg et al., 2017; Damon et al., 2019; Angrist et al., 2020; Springer and Miller-Grandvaux, 2022). This is not to say that there are no gaps in the evidence base, but it is generally more comprehensive than the other domains.

Domain 3 on safety and a supportive environment contains elements that have been studied in some detail and these studies support the development of models for investment returns analysis. Here we have developed, or relied upon, studies that provide evidence of the high ROI in protective interventions to lessen the risk of violence or injury in specific areas. These are child marriage, female genital mutilation (FGM) and road traffic injuries (Rasmussen, Maharaj et al., 2019; Katz et al., 2021; Symons et al., 2019). We are conscious, however, of the many other equally important areas of adolescent safety for which quantitative studies are not available. One that is receiving increasing attention is intimate partner violence, but at this stage, the information is not yet available to support this form of investment case (Ferrari et al., 2022). Considerations of inequality and human rights remain, of course, powerful reasons for investment in such areas.

Outside these specific domains, the broader issue of IPV among adolescent males, including in war and terrorist activity, is one of the more prominent causes of male adolescent death and injury, but interventions to prevent this are missing from investment case analysis (Wodon et al., 2021).

Two other domains are conceptually very important for adolescent well-being. These are Domain 2 on connectedness, positive values and contribution to society and Domain 5 on agency and resilience. Those individuals who have high levels of these attributes are more likely to thrive and be able to survive the emotional and physical challenges of adolescence. The fact that data limitations restrict the application of the investment evaluation approach adopted in this report should not be taken as casting doubt in any way on the importance of these domains to adolescent well-being.

The case study presented in Chapter 3 was developed based on the results of the Strengthening the Evidence base on scHool-based intErventions for pRomoting adolescent health (SEHER) study in Bihar (Shinde et al., 2018), which links school connectedness to mental health and education impacts. This is a rare attempt to demonstrate that interventions to improve connectedness (in this case, to school and schoolmates) can have measurable outcomes, resulting in a cost-benefit analysis with a significant BCR of 25.6.

1.4.2 Multi-country models and local implementation

The multi-country models used here inevitably employ estimated data on key parameters drawn from existing studies that cover many countries in most cases. Thus, the models have a limited ability to tailor the intervention parameters to the situation of a specific country or indeed to model those interventions that will be most effective in that specific country.

Each country should invest in the set of interventions likely to be most effective in the country's specific conditions with cost and impact parameters shaped as far as possible by local conditions and knowledge. One modelling approach that may assist with this selection process is that of optimization across interventions to determine a suite of interventions that will achieve a given level of the target outcome (for example, reduction in child marriage) most effectively. Some results of this approach are discussed in Chapter 7. For a given country, the selection of the optimum suite of measures to achieve a given end is necessary and, inter alia, should give a higher BCR than that from the standard model.

1.4.3 Uncertainty in BCR estimates

The BCR results reported in Tables 1.3 to 1.6 emerge from complex analyses in which many decisions need to be taken on modelling methodologies, parameter values and other factors. In many cases, these decisions must be taken on the basis of the best information available, although that information is often quite limited. For technical reasons, it has not been possible to provide meaningful formal estimates of uncertainty levels. It should be recognized that the uncertainty ranges around the point estimates provided are likely to be substantial, but also that the point estimate BCR results are high.

1.5 Key investment priorities

On the basis of discussions with the Expert Consultative Group and our own analyses, we have identified the following priority areas for action, recognizing that many other areas in this complex picture could have also been highlighted.

1.5.1 Malnutrition

Malnutrition, which covers undernutrition, overweight and obesity, remains a critical challenge for current and emerging adolescent cohorts. Indeed, the DBM affects most LICs and MICs (Popkin et al., 2020). DBM increased in many LICs and MICs between 1990 and 2010, with Indonesia having seen the biggest increase among larger countries. But many other Asian and sub-Saharan countries have also seen big increases in DBM.

Sustained action to address these issues has been widely discussed in the literature and some modelling has been done. The impact of malnutrition comes through three channels:

- inadequate intake of micronutrients, such as various vitamins, iron, iodine, zinc and folic acid, which can predispose adolescents to various adverse effects, such as cognitive defects, maternal haemorrhage, birth defects and diseases;
- hunger and macronutrient or protein-energy undernutrition, giving rise to stunting, underweight and thinness; and
- overweight and obesity, giving rise inter alia to NCDs, including poor cardiovascular health and an increased risk of cardiovascular disease in later life.

The key interventions to address undernutrition in adolescents are micronutrient supplements of various types and the expansion of school feeding programmes integrated with programmes to provide micronutrient-fortified foods. There is increasing empirical evidence on such school feeding programmes, suggesting that they provide high returns. These programmes are explored in Chapter 5.

The key messages of the important 2023 multi-agency review led by UNESCO, summarized in Table 1.7, highlight the importance of both school health and nutrition programmes as part of a broad enhanced schools programme.

*Table 1.7 **School health and nutrition programmes — a summary of the key messages of the multi-agency report** Ready to Learn and Thrive **(UNESCO, UNICEF and WFP, 2023)***

1. The health, nutrition and well-being of learners are key determinants of education outcomes;

2. Almost every country in the world implements school health and nutrition programmes;

3. Such programmes are cost-effective and feasible in all settings and deliver significant gains;

4. School health and nutrition programmes promote inclusion and equity in education and health;

5. More attention must be paid to the school environment, critical to health and learning; and

6. More comprehensive and sustained school health/nutrition programmes are required.

1.5.2 Mental health prevention and treatment

Mental health conditions are among the leading causes of illness and disability among adolescents. Such disorders represent 13% of the global burden of disease for adolescents, as measured by DALYs lost (WHO, 2021a). The burden of mental disorders is greater for girls than for boys in both adolescent age-groups, with anxiety disorders predominant for 10–14-year-olds but depressive and anxiety disorders both highly prevalent for 15–19-year-olds (WHO, 2023a). There are wide disparities in the burden of mental disorders between countries. Some possible reasons include income per capita and political instability/terrorism, which are significantly correlated with the level of mental disorders. Inequality and the level of youth unemployment also potentially play a role (Viner et al., 2012). For adolescents in many countries, these structural determinants of mental health may have a very large impact on mental health outcomes. However, in formulating preventive interventions to address adolescent issues, it is the determinants much closer to home that are the focus of preventive intervention programmes.

As explored in Chapter 3, connectedness to school is a powerful protective factor against mental health risks such as bullying, and mental disorders including depression and anxiety (Patton, 2000; Bond et al., 2004; Shinde et al., 2018).

School-based SEL programmes conducted by teachers or other trained staff are effective interventions to reduce depression and anxiety (Durlak et al., 2011; Taylor et al., 2017; Corcoran et al., 2018), and have been included in recent WHO guidelines on mental health promotive and preventive interventions for adolescents (WHO, 2020).

Increasingly, social and emotional skills are being recognized as important for child development and involve the ability to respond appropriately to social interactions. In evaluating SEL programmes, attempts are being made to capture mental health benefits, such as reductions in delinquency, conduct disorder, depression and anxiety; education benefits such as improved academic performance and enrolment retention; and direct earnings benefits through higher self-esteem and what are referred to as enhanced soft skills (Belfield et al., 2015).

Mental health problems are one of the largest contributors to the health burden for adolescents. For a detailed analysis of the quantitative assessment of programmes for the prevention and treatment of adolescent mental health see Chapter 4. However, the actual implementation of known successful intervention programmes with demonstrably high BCRs is limited in all countries, spanning the range from low- to high-income. The barriers to the adoption of universal programmes through schools, for instance, need further consideration.

1.5.3 Learning, skills and employment

This is a critical area given that the issue of learning quality has become so central to the global debate, together with the importance of the link between schooling and mental health, bullying, nutrition and school climate (Gray et al., 2022). Many of these matters have been investigated, both within studies reported in the literature and empirical models. The redevelopment for this project of our large, multi-country education model outlined in Wils et al. (2019) has been completed, as has the revision of the employment model (Sheehan and Shi, 2019).

The interventions analysed through these models are listed in Chapter 6. They focus, in particular, on increasing secondary school retention and improving the quality of schooling. One of their short-term impacts is on reducing the pressure of supply on youth labour markets by raising secondary school completion rates. In the longer term, they improve the productivity of cohorts post-school and improve their ability to secure formal rather than informal jobs. The improved human capital of the workforce also enhances the innovation capacity of the economy as a whole. The BCRs derived from the analysis of these interventions are summarized in Table 1.4 above. Interventions related to mental health and child marriage are also considered through these models.

1.5.4 Interventions to improve the position of women

The disadvantage experienced by adolescent girls ranges from implicit discrimination to violent injury and premature mortality. Intervention programmes to address this disadvantage include developing and affirming human and civil rights, working in communities to change cultural and social norms and implementing practical programmes in health and education.

The disadvantage faced by girls has everlasting consequences. More than 200 million women and girls have undergone FGM, which in turn costs health systems US$ 1.4 billion per year to treat the complications from FGM (WHO, 2024). Over 12 million girls are married each year before the age of 18 (UNICEF, 2023a). According to UNESCO, 129 million girls are out of school, including 32 million of primary school age and 97 million of secondary school age. Katz et al. (2021) estimate that employing high coverage targets for 31 countries by 2030, requiring an investment of US$ 3.3 billion, would avert more than 24 million cases of FGM at a relatively modest cost of US$ 134 per girl, although not all would be adolescents. Unplanned pregnancies also often come at a high cost to individual women and to society as a whole.

A cost-benefit study conducted by the Burnett Institute (UNFPA, 2022) on a programme of interventions to end an unmet need for family planning and the prevention of maternal deaths estimated the returns to have a BCR of 8.4. It was not, however, limited to adolescents. Of the total estimated benefits of US$ 660 billion for the period 2022 to 2050, teenage pregnancies averted accounted for US$ 106 billion or 16% of the total.

In developing an investment case for adolescent well-being, we have assembled existing evidence on the success of intervention programmes across many of these dimensions and developed some of our own. These interventions address many, but not all, of the fundamental issues that confront adolescents. There are three important platforms available for the delivery of most of these interventions, as discussed above. These are:

- enhanced school-based intervention programmes incorporating more than basic teaching and learning;
- adolescent health services provided by accessible clinics and hospitals; and
- broad-based community platforms conducted by civil society and government agencies.

Enhanced schools can contribute greatly to improving the position of young women. Accessibility to schools is a major problem for girls in LICs. Schools need to be within walking distance and once there, they need to be girl-friendly. At the most basic level, this may be by the provision of girls-only latrines. These interventions typically have high effectiveness.

Programmes to reduce child marriage are effective in increasing enrolments of girls and enabling more girls to complete secondary school. Intervention programmes generally address three aspects of deterring early marriage:

- economic and other incentives to remain in school;
- empowerment through specific group education programmes, which include life skills, financial literacy, sexual and reproductive health (SRH) and negotiating strategies; and
- community mobilization programmes to change social and cultural norms to increase community support for delayed marriage (Malhotra and Elanakib, 2021; Girls Not Brides, 2023).

Much of the focus of interventions for female adolescents delivered through a health platform is on SRH. Firstly, adolescent girls are entitled to professional advice and information about SRH. Secondly, it is essential that interventions to provide adolescent girls with the capacity to make informed choices about pregnancy and avoid unintended teenage pregnancies are readily accessible. Thirdly, it is important that quality antenatal and postnatal care and safe delivery attended by skilled personnel are available for adolescents. Fourthly, screening and treatment for sexually transmitted infections (STIs) should be available and programmes should be implemented to eliminate harmful gender-based practices, such as FGM (UNFPA, 2022).

As already mentioned, a number of intervention programmes for female adolescents have a community component directed towards persuading influential community leaders to support changed attitudes to longstanding practices. Both child marriage and FGM programmes have benefited from the mobilization of changed community attitudes to early marriage and FGM.

The outcome of a recent systematic review and assessment by Malhotra and Elnakib (2021) of 20 years of evaluations of interventions to reduce child marriage emphasized the importance of education interventions. This included conditional cash or in-kind transfers for schooling support and enhancing the girl's own human capital and employment opportunities. Other successful interventions have included conditional asset transfers for delayed marriage, life skills training (LST) (including gender rights) and, to a lesser extent, community mobilization. Interventions that have had little success include unconditional cash transfers. These have been directed largely at addressing poverty, a factor in child marriage.

The Girls Not Brides (2023) evidence review, discussed in Chapter 7, confirmed how effective cash transfers can be in keeping girls at school and that the supply side of girls' education can be as important as the demand side; often girls are unable to stay at school due to poor availability and quality of schools, particularly at secondary levels) (Malhotra and Elnakib, 2021). Favourable job markets can have a positive impact on keeping girls in school (Rose, 2021), as well as vocational training in areas including tailoring, hairdressing, catering or carpentry, with a view to improving adolescent girls' financial independence (Freccero and Taylor, 2021).

There is much still to be achieved to improve the position of girls and young women. Our analysis suggests that interventions addressing health and education issues that have the most reliable evidence base are likely to be highly effective and cost-effective. However, the scarcity of empirical data on costs and benefits has, so far, hampered the possibility of calculating formal BCRs.

1.5.5 The prevention of violence and injury

Adolescents, and young people more generally, face heavy burdens of violence and injury. These include child marriage, IPV, transport injuries, suicide and other self-harm and violence related to war and terrorism. These diverse elements of violence and injury have a major impact on adolescent well-being and addressing them must be a key priority.

Globally, it has been estimated that over half of children aged two to 17 years, approximately one billion, experienced emotional, physical or sexual violence in 2015 (Hillis et al., 2016). There are many different types of violence perpetrated on adolescents. These include homicide, maltreatment, bullying and intimate partner violence. In humanitarian situations in particular, adolescents are subject to increased forms of violence that include recruitment into conflict, increased trafficking of girls and increased rates of child marriage. The impacts of violence can be long-lasting and intergenerational. A range of countries have estimated that violence against children has economic costs of up to 5% of GDP (UNICEF, 2022), and the global cost of violence against children is estimated at 8% of GDP (Pereznieto et al., 2014).

Violence prevention approaches related to the enforcement of laws that have high BCRs include laws banning firearms and those against serving alcohol to the intoxicated. Strategies that address harmful gender norms are usually undertaken through community mobilization programmes. Ferrari et al. (2022) provided costs for implementing programmes for secondary school girls aimed at changing norms, some of which are effective in terms of DALYs averted. One such initiative, although not exclusively for adolescents, is the Cardiff Violence Prevention Programme (CVPP), a violent crime and injury data-sharing partnership. It generated a BCR of 82 based on the sizeable reduction in injuries and justice system costs (Florence et al., 2014).

Response and support services are usually provided in health care facilities. Educational interventions have the most marked effect on preventing violence. Schools offer an important platform for delivering preventive interventions and have positive impacts on improving educational outcomes. These result in reductions in child marriages, reductions in sexual and intimate partner violence, reductions in bullying behaviour and empowering adolescents to protect themselves from violence.

1.5.6 Engaging adolescents in coping with emerging realities

There is now a powerful body of evidence that the emerging reality of climate change is having a major impact on adolescent well-being. Some are affected directly in terms of actual or anticipated effects on living conditions and/or relocation. Many others share a sense of foreboding about the state of the world that they will inherit (van Nieuwenhuizen et al., 2021; Hickman et al., 2021). This is also true of other ongoing trends, such as the increasing number of zoonotic diseases (diseases in animals that can affect humans) and the ongoing likelihood of further pandemics.

Consistent with the themes of connectedness, agency and resilience, some studies have shown that engaging young people in the response to climate change is an effective way for them to cope with the change. Systematic programmes to engage adolescents in addressing such global and national challenges are likely to be an important part of the policy response. Making effective use of the ongoing digital transformation will be a central element of such programmes.

1.6 Conclusion

Large-scale and immediate investment to increase the capabilities and well-being of adolescents is now of critical importance. This investment will empower young people to meet these challenges before them and to thrive during adolescence and in the decades ahead. The cost of inaction will be very high. However, we show in this report that the returns to these investments – the returns on action – are also high, both in terms of BCRs and in terms of fulfilling human rights and reducing inequalities around the world. The time for action is now.

2. *Health investments*

This chapter reports the ROI from a range of programmes working to reduce the burden of disease among adolescents. Separate epidemiological models were used to estimate the impact of interventions for: (i) selected aspects of reproductive and sexual health, maternal and child health, communicable and NCDs and mental health; (ii) HPV; (iii) TB; and (iv) myopia. Economic models use the output from these models to calculate the ROI from the intervention programmes.

2.1 A broad package of health interventions provided to adolescents

2.1.1 Introduction

This section reports on the modelling of 95 adolescent health interventions using the OHT in 40 LICs and MICs. The countries included in the modelling, which account for more than 80% of the global adolescent burden of disease, are listed in Annex 2, Table A2.1, along with their current World Bank income status (World Bank, 2023a). The group consists of 13 LICs, 17 LMICs and ten upper middle-income countries (UMICs). The results from the OHT modelling are then used in an economic model to undertake an ROI analysis.

This analysis is a quantitative undertaking with both strengths and weaknesses. A key limitation is that, in some important areas of adolescent health and well-being, evidence on the effectiveness of interventions is scarce or non-existent. Examples include intimate partner and other violence, injuries such as drowning and falls, self-harm and suicide, harmful substance use, some neurological conditions, musculoskeletal conditions and some communicable diseases such as typhoid, headaches and lower back pain.

2.1.2 Methods

The approach for this study is similar to the one used in a global study on adolescent health and well-being for UNFPA (Sheehan et al., 2017). It estimates both the health impact and the cost of a programme of interventions designed to reduce adolescent death and disability. The outputs from an epidemiological model are used as inputs to an economic model that estimates the economic and social benefits arising from the interventions.

The OHT model (Avenir Health, 2023) is overseen by the UN Inter-Agency Working Group on Costing, which has developed and governed the tool since the first version was launched in 2012. It estimates the costs and benefits of interventions to address many of the major causes of the adolescent burden of disease, including SRH, as well as a number of communicable and NCDs. Avenir Health undertook the OHT modelling for this project.

Making an investment case for interventions that address adolescent health relies on the following:

- selecting interventions;
- identifying the target population to which the interventions will be delivered;
- specifying what proportion of the target population (population in need) will receive the intervention;
- calculating the cost associated with delivering the intervention; and
- being able to quantify the impact of the intervention on the particular aspect of adolescent health and well-being considered.

The version of OHT used in this study is Spectrum 6.3 Beta 19, which has some 390 interventions across 12 major health programmes and 70 sub-programmes.

It should be noted that the epidemiological models currently available within the tool to undertake cost and health impact modelling do not cover the full set of diseases and risk factors. Future expansions of the modelling framework are planned.

In the current version of the model, from a total of 390 there are 181 interventions for which the model also calculates health outcomes in terms of mortality, morbidity, fertility and other demographic characteristics. For the remaining interventions, the tool calculates costs only (no impact) and therefore these interventions were excluded from the modelling.

The modelling approach described below relies on comparing the benefits and costs from two different scenarios to address adolescent health over a specific period. These two scenarios (base and scale-up) were developed with an intervention period of 2023–2035.

OHT files were set up for each of the 40 countries included in the modelling. Ninety-five interventions were chosen to be included in the modelling based on their relevance to adolescents and their importance in addressing the adolescent burden of disease. These are listed in the format used by OHT in Annex 2, Table A2.2, and are similar to those used in previous studies of adolescent health (Sheehan et al., 2017; Sweeny et al., 2019; Rasmussen, Sheehan et al., 2019).

For each set of interventions chosen in OHT, the target population was also specified (for example, adolescents aged 10 to 19 years). The population in need of treatment was determined as a percentage of the target population and then the baseline and target treatment coverage rates for this population were specified. The cost and impact of interventions are therefore modelled as a result of changing treatment coverage rates.

For the base scenario, the baseline coverage rates were kept constant over the period to 2035. For the scale-up scenario, target coverage rates in 2035 were set at 1.25 times the rate in 2023, except for some NCD interventions for which the target rates in 2035 were set using global targets. A linear scale up from 2023 to 2035 was modelled. Further details of the modelling methodology are included in Annex 1.

2.1.3 Cost

For the health model, the approach to estimating the costs associated with the two scenarios is similar to that for the reproductive, maternal, newborn and child health (RMNCH) set out in Stenberg et al. (2014) and used for the UNFPA global adolescent health study (Sheehan et al., 2017; Sweeny et al., 2019). The OHT includes default cost assumptions for the resource inputs needed to provide each health service, including drugs and supplies, service delivery inputs, and health workforce time. The results from the OHT modelling were aggregated to provide estimates by country and year of the costs of drugs and supplies, the number of inpatient days, the number of outpatient visits and the amount of personnel time in minutes per health intervention and per service delivery platform.

The cost of inpatient days was calculated by multiplying the number of days by the WHO CHOICE estimates of the average cost per bed day for each country (WHO, 2011) expressed in US dollars at 2023 values. Similarly, the cost of outpatient visits was estimated by multiplying the estimated number of outpatient visits by the WHO CHOICE estimates of the average cost per outpatient visit for each country. These service delivery costs from the WHO database are estimated by country and differentiated by service delivery platform. The cost of personnel time was calculated by multiplying the personnel time in years by country by WHO CHOICE estimates of the average country-specific annual salaries for physicians, nurses and other health workers expressed in US dollars at 2023 values (Serje et al., 2018).

The other components of cost: supply chain, infrastructure and equipment, governance, health information systems, health financing, emergency and reconstruction and additional programmes were calculated as a markup of the combined direct costs of drugs and supplies, inpatient days, outpatient visits and personnel time. Results from a study that looked at the investment needed to advance the UHC agenda in 67 countries for the period 2016 to 2030 (Stenberg et al., 2017, Tables S16–S17) indicated that the total investment cost is, on average, 2.2 to 2.5 times the combined direct costs. As some of the costs included within their estimates are not likely to be applicable for the adolescent investment case, we estimate total costs as two times the combined direct costs. The effects of varying these multipliers is planned in future work.

All costs were expressed in US dollars at 2023 prices and where necessary prices were adjusted from their base year to 2023 using the United States of America GDP implicit price deflator (US BEA, 2023).

2.1.4 Health outcomes

The reproductive, sexual and other health outcomes from modelling interventions with the OHT are usually expressed as the number of deaths and amount of morbidity that occurs for each health condition each year for each age group and sex (where this is available). For some areas within the OHT, it is possible to obtain health outcome data by age and sex, in which case the impact on adolescents could be assessed directly. In other areas, this data is for the whole of the population being targeted, in which case the adolescent proportion was calculated according to that used for allocating costs based on population proportions.

In addition, estimates were made of the numbers of mothers and newborns with serious disabilities, as well as the number of adolescents with serious disabilities arising from each of the NCDs being modelled. Based on the analysis by Stenberg et al. (2014), it was assumed that, for adolescent mothers, the number with a serious disability from obstructed labour was six times that of the number of deaths with half of these being unable to work and half able to work at 50% of the productivity of a healthy adolescent. Similarly, the number with a serious disability from other maternal disorders was estimated to be twice the number of deaths from this cause divided equally between those unable to work and those able to work at 50% productivity. A similar approach was used to estimate serious disability associated with the causes of newborn deaths. Serious disability from prematurity was assumed to be 1.65 times the number of deaths, from asphyxia 0.9 times, and from congenital abnormalities equal to the number of deaths..

The assumptions about scale-up in the contraceptive prevalence rates for adolescents over the period to 2035 were projected to reduce adolescent fertility rates on average from 79.1 to 60.6 per 100 000 (see Annex 2, Table A2.3) and a reduction in births to mothers aged 15–19 of 21 929 016 (see Annex 2, Table A2.4).

The model indicates that the increased service coverage would lead to reductions in deaths among adolescent mothers of 144 840, newborns of 1 048 207 and children of 825 874, as well as in stillbirths of 695 835 (see Annex 2, Table A2.5). The model also indicates smaller projected reductions in deaths from alcohol dependence (9551), bipolar disease (169 283), depression (10 097) and epilepsy (2632) (see Annex 2, Table A2.6). The model also indicates large projected reductions in the numbers of adolescents with anaemia (22 758 155), particularly for pregnant adolescents (21 231 485) (see Annex 2, Table A2.7), and in the number of stunted children born to adolescent mothers (26 526 759) (see Annex 2, Table A2.8).

Among adolescent females, the interventions included for mental disorders and other NCDs are estimated to reduce the number of cases of depression (3 067 243), anxiety (2 007 641) and epilepsy (526 765), and, to a lesser extent, alcohol dependence (205 214), asthma (334 336), attention disorders (35 330) and conduct disorders (72 006) (see Annex 2, Table A2.9). Among adolescent males, the interventions included for mental disorders and other NCDs would be expected to reduce the number of cases of depression (2 309 561), anxiety (1 629 340) and epilepsy (632 039), and to a lesser extent, alcohol dependence (652 195), asthma (523 295), attention disorders (96 836) and conduct disorders (216 609) (see Annex 2, Table A2.10).

2.1.5 Economic and social benefits

To estimate the ROI for health intervention programmes, it is necessary to express the improved health outcomes in economic terms and compare these with the costs of the programmes. As noted above, the approach builds on previous studies (Sheehan et al., 2017; Sweeny et al., 2019) focused on economic and social benefits and is described below.

Economic benefits

Comparing an intervention scale-up scenario with a base scenario enables the number of deaths and amount of morbidity averted to be calculated and compared to the additional cost. Within our model, we consider that the economic benefits of interventions preventing deaths occur when people who would otherwise die prematurely enter the workforce and produce economic output. A similar benefit occurs for people who would otherwise suffer a serious disability that prevents them from working.

In this study, the economic modelling of mortality follows the cohort of deaths averted for each of the years from 2023 to 2035. Each cohort is classified by age and sex. As the cohort ages, it is subject to the mortality rates applicable to that age group, sex and year based on estimates from the UN World Population Prospects data (UN, 2022b) for each of the 40 countries. The effect of avoided mortality on the labour force is calculated by taking the numbers of deaths avoided by age and gender and applying a corresponding

labour force participation rate for this age, gender and year sourced from the International Labor Organization (ILO) projections of labour force participation rates (ILO, 2023) in each of the 40 countries.

The contribution that each of these labour force cohorts makes to economic output is calculated by multiplying the number in each age and sex category by a productivity level that varies with age and year. To do this, the average productivity is first calculated by dividing the World Bank estimate of GDP in current US dollars by the labour force for the most recent year for which data are available (2021) (World Bank, 2023b). This average productivity then increases at an annual rate determined by the country's income status. The methodology for this is described in more detail in Sweeny et al. (2019).

Based on this analysis, the modelling assumes that annual productivity growth for LICs, LMICs, UMICs and HICs is 2.1%, 2.5%, 1.6% and 0.7%, respectively. Further, it is assumed that the country's income status changes after 15 years. For LMICs and UMICs, this results in slower productivity growth after 15 years.

Productivity varies by age so, as a proxy for this, the distribution of hourly wage rates by age for Australia for 2021 (ABS, 2022) is used. Average productivity for each age group is calculated by multiplying average productivity by the ratio of hourly wage rates for the age group to overall hourly wage rates. The total GDP generated is calculated by summing the GDP produced by each cohort for each year of the period in which they are in the labour force using ILO projections of labour force participation rates and productivity estimates to calculate the contribution to GDP each year. The contribution to GDP of each cohort of persons who would otherwise suffer from serious disabilities is calculated in a similar way as for mortality, using the same assumptions about participation rates and productivity.

Social benefits

Health has an intrinsic value and, in addition to the market value put on health improvements (here captured by labour productivity), many studies apply a value of a statistical life (VSL) approach. This allows researchers to fully capture the value of the social benefit of health improvement. Following past approaches, we consider social benefits as a subset of the VSL year. Building on the results of Viscusi and Aldy (2003), Jamison et al. (2013) estimated the value of a life year as between 1.4 and 4.2 times GDP per capita, averaging 1.6 globally. This is a partial VSL method where GDP per capita is projected for each country.

Stenberg et al. (2014) applied an approach in which benefits not captured in labour productivity measures were referred to as "social benefits." The social benefits were estimated within a VSL envelope that was, on average, assuming the value of a life year as 1.5 times GDP per capita. As the calculated economic benefit in the Stenberg et al. (2014) study represented roughly one times GDP per capita, this left a residual value of 0.5 times GDP per capita as the estimated social benefit. In other words, the economic benefits as a share of GDP vary by country but the social benefits are valued at the same rate (0.5 GDP per capita) across all countries. Following the same approach, a value of 0.5 GDP per capita is assigned to each healthy life year gained (HLYG) from the interventions to estimate the social benefit of improved health.

2.1.6 ROI in adolescent health

The rate of ROI can be expressed in a number of different but related ways. In this study, we report BCRs as they are intuitively easier to understand. The BCR divides the estimate of benefits by the estimate of costs. A BCR greater than one means that the benefits of an intervention programme are greater than the costs of the programme.

The economic benefits, social benefits and the cost of intervention programmes are reported in Annex 2, Table A2.11, based on the calculations described in the previous sections. It is standard practice when calculating BCRs to express these benefits and costs in NPV terms. Given benefits and costs for years in the future are usually regarded as having a lower value than those in the present, a discount rate is applied to these future benefits and costs. Most analyses of long-term projects adopt the standard World Bank discount rate of 3% to calculate NPVs (Weitzman, 2001; United States Office of Management and Budget, 2003; Arrow et al., 2013; Campos et al., 2013).

Table 2.1 (and Table A2.11 in Annex 2) shows the benefits, costs and BCRs in terms of US dollars. The economic benefits in the 40 countries modelled arising from the increase in the workforce equate to US$ 112 632 million. The social benefits equate to US$ 60 964 million, with an overall benefit of US$ 173 596 million.

Overall, the unweighted BCR arising from the investment in adolescent health is 9.6, using the World Bank standard 3% discount rate when considering all benefits. This is similar to the average BCR reported for the UNFPA adolescent investment case (Sheehan et al., 2017) for all countries in that study, which was 10.0. These BCRs are significantly higher than one, which is the break-even value when benefits equal costs.

Table 2.1 **Adolescent health, economic and social benefits, costs ($ million), and BCRs**

	Economic benefit	Social benefit	Cost	BCR economic	BCR economic & social	BCR economic	BCR economic & social
				Unweighted average		Weighted average	
Low-income	16 975	8 076	5 857	6.9	10.2	2.9	4.3
Lower middle-income	73 061	39 633	11 598	7.7	11.8	6.3	9.7
Upper middle-income	22 596	13 255	14 751	3.2	5.0	1.5	2.4
All countries modelled	112 632	60 964	32 206	6.3	9.6	3.5	5.4

Note: See description of weighted and unweighted average in section 1.3.2. Source: Estimates from modeling.

2.1.7 Discussion

Successfully achieving the SDGs and the goals of the Global Strategy for Women's, Children's and Adolescents' Health 2016–2030 (WHO, 2018a) will require investment metrics to support informed decision-making on appropriate interventions. This study has demonstrated high rates of ROI targeting key aspects of adolescent health with a BCR of 9.6, with benefits greatly exceeding costs. This means that for each dollar invested, there will be US$ 9.6 returned in benefits.

The BCRs comfortably exceed one at the 3% discount rate typically used in analysing health projects and for the other discount rates used for a sensitivity analysis.

These results are similar to those obtained in the global adolescent investment case (Sheehan et al., 2017; Sweeny et al., 2017). They are also close to the results of the more general investment case for RMNCH (Stenberg et al., 2014), which estimated a BCR of 8.7 at the 3% discount rate for a similar range of interventions modelled using OHT.

However, the analysis presented here differs in a number of significant ways from that reported in previous studies. In Stenberg et al. (2014), the number of interventions modelled was 50 and restricted to RMNCH. For the study for UNFPA on adolescent health (Sheehan et al., 2017), the number of interventions was 66 while the current study focuses on 95 interventions. Experience with previous studies informed more targeted interventions but also pointed to the inclusion of a range of public health interventions addressing risk factors and additional NCDs, such as asthma, psychosis and conduct disorders.

The period modelled in the UNFPA study was 2015 to 2030. In this study, the period is 2023 to 2035. The costing methodology has drawn upon updated estimates of resource needs as presented in Stenberg et al. (2017).

Studies on stillbirths (ten Hoope-Bender et al., 2016), depression and anxiety (Chisholm et al., 2016) and cardiovascular disease (Bertram et al., 2018) using the OHT have also reported ROIs of similar magnitude.

The intergenerational benefits of improving the health of adolescents in preparation for parenthood are beginning to be explored in detail, and it is likely that quantifying these benefits will further demonstrate the value of interventions in adolescence.

Achieving the strong ROIs suggested by these models will require that programmes are skillfully designed and implemented. They must also respond to the needs of adolescents by meeting the requirements of adolescent-friendly health services and ensuring the delivery of interventions to decrease risky behaviours, improving protection and avoiding unwanted pregnancies. Ensuring quality in service delivery is crucial for effective programmes (Duber et al., 2018).

Limitations

In general, the interventions included in the modelling had to have both an estimated health impact and cost, and tools available to run the analysis (here, the OHT was used, but other tools could also be applied). Consequently, some areas that are prominent in the GBD estimates for adolescents were not included (for example, prevention of drowning and other accidental deaths and self-harm) as there were insufficient associated interventions with known impacts and costs.

Although it would increase the ROIs, any health expenditure savings due to the interventions have not been included in the calculation of benefits as there is limited information on health expenditure by disease in many countries. This benefit would be expected to be substantially smaller than the economic contribution that was used as the basis of our benefit modelling, but would nonetheless lead to higher estimates of the ROI.

2.2 HPV

2.2.1 HPV vaccination and cervical cancer elimination

Cervical cancer is the fourth most common cause of neoplasm mortality among women worldwide, accounting for 341 831 deaths in 2020 (IARC, 2023). Persistent infection by selected types of HPV is a necessary step in the pathogenesis of cervical cancer (Walboomers et al., 1999). HPV also contributes to the pathogenesis of several less prevalent cancers, such as cancers of the vagina, vulvae, penis, anus and oropharynx (throat).

There are over 170 different types of HPV. More than 40 types are typically transmitted through sexual contact and infect the anogenital region. Several of these are high-risk HPV types that can contribute to the development of cancer. HPV types 16 and 18 are associated with 70% of cervical cancers, 80% of anal cancers, 60% of vaginal cancers and 40% of vulvar cancers. Several types of HPV, particularly type 16, have been found to be also associated with oropharyngeal cancer, which affects the middle part of the throat and includes the base of the tongue, the tonsils, the soft palate and the walls of the pharynx.

The International Agency for Research on Cancer (IARC) has reviewed the evidence on the role of HPV in different cancers. Their meta-analysis of type-specific HPV DNA prevalence in cervical cancer indicated that HPV types 16 and 18 are responsible for 54.4% and 15.9% of cervical cancer, respectively, with HPV types 31, 33, 45, 52 and 58 being responsible for a further 17.3%. HPV types 6 and 11 are responsible for 0.65% (IARC, 2012).

There are currently three main types of HPV vaccine available:

- Cervarix (GSK), protecting against HPV types 16 and 18;
- Gardasil 4 (Merck), protecting against HPV types 16, 18, 11 and 6; and
- Gardasil 9 (Merck), protecting against HPV types 16, 18, 11, 6, 31, 33, 45, 52 and 58.

Using the evidence from IARC, this means that Cervarix, Gardasil 4 and Gardasil 9 can prevent 70.3%, 70.9% and 88.3% of cervical cancers, respectively. Current HPV vaccines are prophylactic, not therapeutic; they need to be administered prior to a HPV infection. The vaccines were initially recommended for girls before they become at risk of HPV infection so before they become sexually active.

In 2020, WHO released its global strategy towards the elimination of cervical cancer as a public health problem (WHO, 2020b). This strategy has the following targets to be achieved by 2030:

- 90% of girls fully vaccinated with the HPV vaccine by 15 years of age;
- 70% of women screened with a high-precision test at 35 and 45 years of age; and
- 90% of women identified with precancerous lesions and cervical disease receiving treatment and care.

These targets are often referred to as the 90–70–90 strategy. It is supported by the International Papillomavirus Society (Garland et al., 2018). Based on analysis by Bertram and Gauvreau (cited in WHO 2020b), the strategy claimed that:

Investing in the interventions to meet the 90–70–90 targets offers immense economic and societal benefits. An estimated US$ 3.20 will be returned to the economy for every US$ 1 invested by 2050, owing to increases in women's workforce participation with this figure rising to US$ 26.00 when societal benefits are incorporated.

Victoria University has undertaken a number of projects estimating the ROI from vaccination against HPV and screening and treatment for cervical cancer (e.g., Sheehan et al., 2017; Rasmussen, Sheehan et al., 2019). A study on the investment case for HPV vaccination in Viet Nam for UNFPA was undertaken with the Daffodil Centre at the University of Sydney, a joint venture with the Cancer Council New South Wales (Sweeny, Nguyen et al., 2023).

2.2.2 Epidemiological modelling

Studies of the feasibility and cost-effectiveness of widespread HPV vaccination programmes have relied on epidemiological models to predict the alleviation of the burden of cancer. This is based on the impact of the vaccine on the known precursors of HPV-attributable cancers, such as HPV infection and precancerous cervical lesions. Once the efficacy of the HPV vaccine had been established, a number of studies were undertaken on the effectiveness and cost-effectiveness of widespread vaccination programmes. These studies are reviewed in Sweeny, Nguyen et al. (2023).

In a recent study across 78 LICs and MICs, the Daffodil Centre, in conjunction with colleagues from the WHO Cervical Cancer Elimination Modelling Consortium, assessed the impact of achieving the 90–70–90 triple intervention targets on cervical cancer mortality and deaths averted over the next century (Canfell et al., 2020). They found that in the next 10 years, a one-third reduction in the rate of premature mortality from cervical cancer in LICs and MICs is possible, and over the next century, successful implementation of the WHO elimination strategy would reduce cervical cancer mortality by almost 99% and save more than 62 million women's lives.

To undertake these analyses, the Daffodil Centre has developed the Policy1-Cervix model, which is a dynamic model of HPV transmission, HPV vaccination, cervical precancer, cancer survival, screening, diagnosis and treatment. The model has been validated extensively and used for a number of screening and vaccination evaluations across a range of countries. It is described in detail in Simms et al. (2019), Canfell et al. (2020) and Sweeny, Nguyen et al. (2023).

For the purposes of this report, the Policy1-Cervix epidemiological and economic modelling compares a base scenario with a scale-up scenario.

The base scenario is a continuation of the status quo with low levels of vaccination, screening and treatment. The scale-up scenario assumes girls-only vaccination at nine years old with a catch-up for girls aged 10–14 years and twice-lifetime HPV testing at age 35 and 45 years with cancer treatment scale-up. Vaccination was assumed to scale up to 90% coverage. Cervical screening involves HPV testing at ages 35 and 45 years with scale-up to 45% coverage by 2023, 70% by 2030, and 90% by 2045. In addition, it is assumed that 50% of women who are diagnosed with invasive cervical cancer will receive appropriate surgery, radiotherapy and chemotherapy by 2023, which will increase to 90% by 2030. These assumptions align with the goals of the WHO global strategy towards the elimination of cervical cancer.

We have assumed that full efficacy was achieved with two doses of a 9-valent vaccine for recipients younger than 15 years and with three doses for older recipients.

2.2.3 Economic model

The health and cost outcomes can be used as inputs to an economic model that estimates the ROI from each scenario. This approach has been used in a number of studies (Stenberg et al., 2014; Chisholm et al., 2016; Bertram et al., 2018; Sheehan et al., 2017; Sweeny et al., 2019). In a study for the UNFPA on the ROI for adolescent health, a simplified model was used to calculate the ROI for an HPV vaccination programme for 75 LICs and MICs (Sheehan et al., 2017). A similar approach was used in a study for UNICEF on an adolescent investment case for Burundi (Rasmussen, Sheehan et al., 2019).

The economic benefits and social benefits were calculated as described in section 2.1.5.

In order to compare the economic benefits and costs associated with the intervention programme, both were expressed in terms of NPV using the standard World Bank discount rate of 3%. A common investment metric is the BCR and this is calculated by dividing the economic and social benefits by the cost, both in NPV terms.

2.2.4 Results

The Daffodil Centre modelled the impact of the base and scale-up scenarios over the course of 100 years. In order to make the health and economic outcomes comparable to other studies in this report, we estimated outcomes over the period 2023 to 2035 by adjusting the modeling results by 13/100.

Table 2.2 (and Table A2.12 in Annex 2) reports the results of the modelling for HPV. The scale-up scenario will avert 8 123 880 deaths from cervical cancer across the 78 countries compared to the base case scenario, with most of these in LICs (2 575 618) and, especially, LMICs (5 136 439).

Table 2.2 **ROI from scale-up of HPV vaccination, screening and treatment, BCRs at 3% discount rate**

Status	Deaths averted	Economic benefit, $M	Social benefit, $M	Cost $M	BCR economic	BCR economic plus social	BCR economic	BCR economic plus social
					Unweighted average		**Weighted average**	
Low- income	2 575 618	12 344	6 297	1 616	10.5	16.0	7.6	11.5
Lower middle- income	5 136 439	47 278	31,185	4 036	14.6	23.4	11.7	19.4
Upper middle-income	411 823	6 217	5 019	427	6.2	11.5	14.6	26.3
All countries	8 123 880	65 839	42 500	6 079	12.7	20.2	10.8	17.8

Note: See the description of weighted and unweighted averages in section 1.3.2. Source: Estimates from modeling.

For a total cost of US$ 6 079 million, there will be economic and social benefits of US$ 65 839 million and US$ 42 500 million, respectively. Dividing the total economic benefits by the total cost will result in a weighted average BCR of 10.8 and 17.8 if social benefits are included. Averaging across the BCRs of the 78 countries gives unweighted BCRs of 12.7 and 20.2.

There are significant differences among countries reflecting differences in HPV and cervical cancer death rates, productivity, income status and other characteristics.

The analysis presented here differs significantly from that included in the UNFPA study (Sheehan et al., 2017). This study includes the three aspects of the WHO cervical cancer elimination strategy—vaccination, screening and treatment—while the UNFPA study only included vaccination. The assumptions about the base and scale-up scenarios also differ in assumptions about the number of vaccine doses and their prices. Importantly, this analysis uses a proven large-scale epidemiological model to estimate the health and cost impacts of the scenarios. The two studies also have different intervention periods.

2.3 TB

This section estimates the ROI from achieving the WHO End TB Strategy for adolescents in 50 countries, which account for 95.7% of adolescent TB deaths and 71.3% of cases. A number of countries are eligible for funding for the prevention of TB from the Global Fund to Fight AIDS, Tuberculosis and Malaria. This fund enables strategic investment to accelerate the elimination of human immunodeficiency virus HIV/acquired immunodeficiency syndrome (AIDS), TB and malaria, and build resilient and sustainable systems for health.

The Global Fund's eligibility policy is designed to ensure that available resources are allocated to and invested in countries and regions with the highest disease burden, the least economic capacity and where key and vulnerable populations are disproportionately affected by the three diseases. Eligibility is determined by a country's income classification and disease burden. All LICs and LMICs are eligible regardless of disease burden.

UMICs must have at least a high burden of disease to be eligible for financing. Table A2.13 in Annex 2 lists those UMICs eligible for TB prevention funds.

2.3.1 Cost per death averted

The Lancet Commission on TB (Reid et al., 2019) reported on a number of studies that had estimated the cost per TB death averted since the introduction of the WHO End TB Strategy in 2014. This strategy aims to end the TB epidemic by 2030 (WHO, 2015, 2019).

Reid et al. (2019) quoted costs per TB death averted of between US$ 5000 and US$ 6000 from Jamison et al. (2013), US$ 7000 from a study by the Stop TB partnership (2015), US$ 8000 to US$ 16 000 in the WHO Global Tuberculosis report (WHO, 2018b) and a range of other values (US$ 700 to US$ 5000) from studies done by the Copenhagen Consensus.

Included in the supplementary material to the Lancet Commission report (Reid et al., 2019) are two figures showing cost of deaths averted for 30 high burden countries for both drug-susceptible TB and multidrug-resistant TB (MDR-TB). The costs per death averted for drug-susceptible TB for countries such as the Democratic Republic of the Congo, Kenya, Mozambique, the United Republic of Tanzania and Zambia are in the range of US$ 1000 to US$ 1500 at 2017 prices. For MDR-TB, the values for United Republic of Tanzania and the Congo are around US$ 15 000, but are significantly higher for Mozambique, Democratic Republic of the Congo and Kenya.

The most recent edition of the Global Plan to End TB by the Stop TB Partnership (2022) includes modelling by the Copenhagen Consensus of the cost and impact of the Global Plan to End TB, 2023–2030. The Copenhagen Consensus found that implementing the Global Plan would reduce death rates from TB by the amounts shown in Table A2.14 in Annex 2. To convert these death rate estimates into numbers of deaths averted we have multiplied the death rates by population projections for the years 2023 to 2030, taken from the latest UN World Population Prospects (UN, 2022b). These numbers are shown in Table A2.15 in Annex 2. The resulting estimates of deaths averted are shown in Table A2.16 in Annex 2. Table A2.17 in Annex 2 shows the estimates by the Stop TB Partnership of the cost of achieving these reductions in TB deaths, expressed in constant US dollars at 2020 prices. These costs include treatment, prevention, screening and other programme costs.

Dividing the relevant cost, as shown in Table A2.17 in Annex 2, by the corresponding deaths averted, as shown in Table A2.16 in Annex 2, gives the cost per death averted, shown in Table A2.18 in Annex 2.

Table 2.3 shows the average cost per death averted across the period 2023 to 2030 in 2020 US dollars. To express these in current 2023 US dollars, the figures were multiplied by the increase in the United States of America GDP deflator from 2020 to 2023 (9.8%).

Table 2.3 **TB in adolescents, cost per death averted, average 2023 to 2030, US$**

	Average 2023–2030	At 2023 prices
Low-income countries	2 986	3 279
Lower middle-income countries	2 665	2 926
Upper middle-income countries	11 656	12 798
High-income countries	26 467	29 061
Eligible upper middle-income countries	4 160	4 568

Source: Estimates from modeling.

2.3.2 Deaths averted

For each of the 50 countries and territories, we obtained the TB death rates for those aged between 10–14 and 15–19 by sex for each of the years 1990 to 2019. Using the average annual rate of change in TB deaths for the five-year period to 2019, we projected the death rates from TB for the two age brackets by sex to 2035.

For a base scenario, we used the most recent population projections for females and males for the two age groups from the latest UN World Population Prospects (UN, 2022b) for the years 2020 to 2035, and estimated the number of deaths from TB based on these projected death rates.

Death rates were projected under an alternative scale-up scenario, assuming a linear decline to death rates in 2035 that were 10% of those in 2023. The number of deaths from TB based on these alternative projected death rates was calculated in the same way.

The difference between the numbers of deaths in the base case and scale-up scenarios is the number of TB deaths averted. This is reported in Table A2.19 in Annex 2 for males and females aged 10–14 and 15–19 years. For the 50 countries, the model estimates that there will be 54 229 deaths averted for adolescent females and 62 334 for males.

The cost of reducing the burden of TB among adolescents is estimated by multiplying the number of deaths averted (Table A2.19) by the cost per death averted (Table A2.18), depending on the country's/entity's World Bank income status in 2023. This simplified approach differs from that used in the other health modelling, which uses direct estimates of treatment and other costs.

2.3.3 Economic and social benefits

The economic and social benefits were calculated as described in section 2.1.5.

2.3.4 ROI on TB

The ROI measured by BCRs was calculated as described in section 2.1.6.

The economic benefits, social benefits and the cost of intervention programmes using the main health model are reported in Table A2.20 in Annex 2, based on the calculations described in the previous sections and expressed in NPV terms. As noted previously, because benefits and costs for years in the future are usually regarded as having a lower value than those in the present, a discount rate of 3% per year is applied to these future benefits and costs.

Table 2.4 (and Table A2.20 in Annex 2) shows the benefits, costs and BCRs in terms of US dollars. The total cost in NPV terms from 2023 to 2035 for the scale-up compared to the base scenario is US$ 286 million. The economic benefits from the increase in the workforce are US$ 10 852 million and the social benefit is US$ 4473 million, with an overall benefit of US$ 15 325 million. The unweighted and weighted ROI measured as BCRs is 39.4 and 37.9, respectively, based on economic benefits and 54.4 and 53.6, respectively, for economic and social benefits combined.

Table 2.4 **TB in adolescents, summary of economic and social benefits, costs and BCRs, 3% discount rate**

	Economic benefit, $M	Social benefit, $M	Cost, $M	BCR economic	BCR economic and social	BCR economic	BCR economic and social
				Unweighted average		**Weighted average**	
Low-income	1 861	638	106	17.6	23.6	18.1	24.6
Lower middle-income	7 725	3 287	157	49.1	70.0	52.9	72.8
Upper middle-income	1 266	548	23	55.4	79.3	67.4	95.9
Total	**10 852**	**4473**	**286**	**39.4**	**54.4**	**37.9**	**53.6**

Note: See the description of weighted and unweighted averages in section 1.3.2. Source: Estimates from modeling.

2.4 Myopia

The prevalence of myopia in children and adolescents is increasing rapidly in many parts of the world (Holden et al., 2016). Grzybowski et al. (2020) estimated that 60% of school children (6–19 years) in Asia and 40% of children in Europe had myopia. The prevalence of high myopia, which can cause pathologic myopia, among young adults is much higher in East Asia than in Western countries (Matsumura et al., 2019).

Myopia is not simply a health problem but has wider implications for well-being. Adolescents with vision impairment reported statistically significant lower quality of life, psychosocial functioning and school functioning scores (Wong et al., 2009). A randomized controlled trial (RCT) among 20 000 children in 250 schools in Western China by Ma et al. (2014) reported that mathematics test scores at the end of a school year had improved significantly among the 1153 children who had failed visual acuity screening and were offered free spectacles.

The FHF and Victoria University have developed an eye health model that provides the basis for evaluating the investment in programmes that scale-up interventions. These reduce the burden of vision impairment across 19 countries and territories where the FHF works and the unmet burden is high (Sweeny, Muirhead and Hennessy, 2023). These are Afghanistan, Bangladesh, Burundi, Cambodia, China, Eritrea, Ethiopia, Indonesia, Kenya, Lao People's Democratic Republic, Myanmar, Nepal, Pakistan, occupied Palestinian territory, including east Jerusalem, Papua New Guinea, Philippines, Rwanda, Timor-Leste and Viet Nam.

The model has been developed for the two leading causes of blindness and vision impairment, namely cataracts and refractive error (myopia and presbyopia). The model estimates the benefits arising from treating these eye conditions in terms of improvements in both health outcomes and economic benefits. It then compares these to the costs of achieving these benefits. The modelling reported here is for interventions to address myopia in adolescents, not cataracts and presbyopia, which are conditions mostly associated with later life.

Much of the evidence used in developing this model, including the assumptions used in the modelling, has been derived from a detailed review undertaken as part of the Lancet Global Health Commission on Global Eye Health (Burton et al., 2020), its supplementary material and related publications.

The eye health model is designed to calculate the impact of an intervention programme on the number of adolescents with myopia. The target population for treatment in a particular year is defined as those with myopia while the coverage rate is the number of people treated as a proportion of the target population. The target coverage rates used in the model are taken from the goals for 2030 agreed at the 74th World Health Assembly (WHA) in April 2021, namely "a 40 percentage point increase in effective coverage of refractive error by 2030" (WHO, 2021c).

For the ROI estimates in this report, the time period for the scale-up of interventions is 2021 to 2030 and the coverage rates are the same for males and females aged 10–14 and 15–19 years. The modelling reported here differs from that in Sweeny, Muirhead and Hennessy (2023), which covered all age groups.

Using data on the prevalence of myopia and these coverage rates, the model estimates the numbers of adolescents treated by age, sex and severity of condition. Using disability weights from the GBD database, it also calculates the number of life years saved, using DALYS and years of sight saved (YSS).

Under the assumptions outlined, reaching the WHA goal for refractive error in the 19 countries and territories would result in treating 2 261 802 female and 2 036 030 male adolescents, as shown in Table A2.21 in Annex 2.

These estimates were used to calculate the economic benefits associated with this improvement in eye health. These benefits arise from improved labour force participation and productivity among working-age patients and improved educational participation and learning by school-age patients. It is important to note that the additional benefits derived from savings to the health system, along with other intrinsic benefits such as increased social participation, were beyond the scope of this model. As such, the benefit estimates provided in this report should be considered a conservative estimate of the total economic benefits of improving eye health.

These calculations use demographic projections from the UN (2019), labour force participation rates from the ILO (2021), and GDP and similar economic data from the World Bank (2023b).

The costs of interventions to achieve the target eye health outcomes were calculated by taking the unit cost of treatment and multiplying this by the number of persons treated, including a factor for an eye-health screening programme. The unit costs were country-specific estimates provided by the FHF.

As stated earlier, it is common with estimates of cost and benefits in the future that they are both discounted at the standard rate of 3% as recommended by the World Bank. The discount rate applied represents the economic notion that a dollar in the future is worth less than a dollar today, and is standard in this type of modelling. Discounting in this way means that benefits and costs are expressed in NPV terms.

The usual way of comparing benefits to costs is the BCR in which discounted benefits are divided by discounted costs. The estimated benefits, costs and BCRs from a myopia treatment programme for adolescents in the 19 countries and territories are given in Table 2.5 (and Table A2.22 in Annex 2). In NPV terms, an expenditure of US$ 9092 million for treating myopia in adolescents would generate an economic benefit of US$ 191 429 million, resulting in an unweighted and weighted BCR of 13.0 and 21.1, respectively.

This BCR is similar to those in other studies using the same methodology across a range of health conditions other than eye health. In our study, the BCRs for the 19 countries and territories range from 3.6 to 38.6 (as shown in Table A2.22 in Annex 2).

The modelling approach used here is described in more detail in the report to the FHF (Sweeny, Muirhead and Hennesy, 2023).

Table 2.5 **Myopia in adolescents, summary of benefits and costs ($ million), and BCRs, 3% discount rate**

Status	Economic benefit	Cost	BCR unweighted average	BCR weighted average
Upper middle-income countries	153 763	5 759	22.1	26.7
Lower middle-income countries	35 315	2 893	14.9	12.2
Low-income countries	2 351	441	4.8	5.3
Total	**191 429**	**9 092**	**13.0**	**21.1**

Source: Estimates from modeling.

3. *Building connectedness, agency and resilience*

Connectedness, resilience and agency are critical to good mental health. Their absence can lead to anxiety and depression. However, making the case for increased investment in building connectedness or improving agency and resilience can be challenging.

This chapter addresses this challenge by exploring the existing literature and offering a case study to demonstrate that significant economic benefits can be estimated from the impact of targeted interventions. The links between connectedness, socioemotional capabilities, mental health and academic attainment provide a possible quantifiable pathway. Taking this pathway can lead to a realization of the high economic returns to be achieved by investing in intervention programmes to reduce mental disorders and improve academic performance.

Connectedness is a term used to describe the important qualitative components of adolescent well-being, such as the sense of belonging at home, school and in the community. Agency provides adolescents with a sense of empowerment to get on and do things in life. Resilience is the capacity to overcome challenges and survive setbacks. While different in nature, they are just as fundamental to adolescent well-being as more quantifiable attributes of well-being, such as skills, education and access to health services. They are also the central concepts for Domains 2 (connectedness, positive values and contribution to society) and 5 (agency and resilience) in the UN H6+ conceptual framework for adolescent well-being (Ross et al., 2020).

Section 3.3 presents a case study based in part on the results of SEHER, a multi-component whole-school health promotion intervention in Bihar, India (Shinde et al., 2018). The case study estimates a BCR of 25.6. It reflects the combined effects of the intrinsic value of improved mental health and, even more importantly, from an economic perspective, the improved school performance that can result in better employment outcomes. To our knowledge, it is the first such study to estimate a BCR linking school connectedness to social and economic outcomes through mental health and education.

Before presenting the results of the case study, sections 3.1 and 3.2 discuss some of the interventions developed to improve connectedness, agency and resilience and the attempts to evaluate the cost-effectiveness of such interventions. The discussion is based on scoping reviews conducted for this report on the effectiveness and cost-effectiveness of programmes to promote adolescents' connectedness to family, school, peers and community (section 3.1), and programmes to promote adolescents' agency and resilience (section 3.2). With the exception of socioemotional learning and some specific intervention programmes to address deviant and criminal behaviour, there are very few investment evaluation studies employing cost-benefit analysis. The Belfield et al. (2015) study of components of socioemotional learning provides estimates of cost and benefits, which permits BCRs in the range of 3.5 to 13.9 to be derived.

3.1 Connectedness

Connectedness means a sense of being cared for and supported as well as the feeling of belonging and closeness with others that comes from protective and sustained relationships within four main areas: family, school, peers and community (Blum et al., 2022). Of these four, family connectedness and school connectedness have been shown to be the most powerful predictors of various indicators of adolescent maladjustment, such as emotional distress, suicidal ideation, violence and substance use (Resnick et al., 1997).

3.1.1 Family connectedness

Blum et al. (2022) indicated that, compared with less connected peers, adolescents who are connected to at least one parent experience fewer emotional problems (Ungar, 2004), fewer suicide attempts (Kuramoto-Crawford, 2017), fewer conduct disorders, better school performance (Gonzalez-DeHass, 2005), higher self-esteem, less involvement in violence (Farrell et al., 2010) and reduced substance use (Wills et al., 2003).

Intervention programmes to support connectedness include parenting programmes and family therapy programmes. Parenting programmes, such as the Triple P (Positive Parenting Program) in the United States of America and other countries, seek to provide greater support to parents and include parent training in discipline styles to deal with parent-teenager conflict and parental depression (Mihalopoulos et al., 2007; Sampaio et al., 2018). Triple P was found to have positive impacts for both parents and adolescents.

Multi-systemic therapy (MST) programmes and functional family therapy (FFT) programmes have been used to reduce adolescent criminal behaviour and recidivism of those paroled or in rehabilitation. MST is a multifaceted short-term home and community-based intervention, which has been used widely in HICs to address a range of adolescent problem behaviours. However, a systematic review of MST by Littell et al. (2021) found that the benefits of MST are not well established nor consistent. They concluded that its benefits may have been overstated. Furthermore, to date, the trials of MST have only been conducted in Western, Educated, Industrial, Rich and Democratic countries (WEIRD), and the interventions may have different effectiveness in non-WEIRD countries.

FFT programmes have been estimated to provide a net economic benefit (Taxy et al., 2012). However, a systematic review of FFT for families (Littell et al., 2023) found no evidence of the effects of FFT compared with other active treatments. Proponents have suggested substantial cost savings, but the Littell et al. (2023) review indicates that the analysis was based on a narrow range of outcomes that may produce inflated estimates of treatment effects.

3.1.2 School connectedness

School connectedness indicates that students are confident that peers and adults in their school support, value and care about their individual well-being as well as their academic progress (CDC, 2022). It has a positive association with school attendance, retention and academic performance (McNeely et al., 2003; Klem and Connell, 2004; Rosenfeld et al., 1998; Battin-Pearson et al., 2000; Barber et al., 1997).

It was also found to be the strongest protective factor for both boys and girls to decrease substance use, school absenteeism, early sexual initiation, violence and risk of unintentional injury (for example, drinking and driving and not wearing seat belts) (Resnick et al., 1997).

School connectedness during adolescence may also have long-lasting protective effects across a range of adult health outcomes including emotional distress, suicidal ideation, physical violence victimization and perpetration, multiple sex partners, STI diagnoses, prescription drug misuse and other illicit drug use (Steiner et al., 2019).

SEL encompasses broad-based programmes with multiple objectives that include connectedness, agency and resilience. They are generally embedded into a school curriculum and aim to help reduce risky behaviours such as violence and drug abuse (Durlak 2011; CASEL 2003). They also form part of programmes designed to enhance non-cognitive skills and improve, among other things, academic performance (Gutman and Schoon, 2013a).

Taylor et al. (2017) conducted a systematic review and meta-analysis of 82 school-based, universal SEL interventions, largely in the United States of America. This involved 97 406 kindergarten to high school students. The study assessed outcomes at six months to 18 years post-interventions and found that there were significant positive effects with intervention participants having stronger SEL skills than those in the control group. Other studies reported by Durlak et al. (2011) and Zins, Weissberg et al. (2004) demonstrate that SEL programmes can enhance academic achievement and attainment through improved school attendance, engagement, and motivation.

Belfield et al. (2015) presented the costs and benefits of some specific SEL programmes based on the results of various studies conducted in Sweden and the United States of America. An outline of these is presented as follows:

- The 4Rs (Reading, Writing, Respect, and Resolution) programme focuses on SEL and literacy development from kindergarten to year five of primary school to ameliorate aggression and violence;

- The Positive Action programme, which is based on the theory that positive action makes us feel good and so becomes self-reinforcing, is a school-based curriculum and supplemental set of school cultural and family activities designed to promote students' positive thinking, actions, and self-concept;

- LST is a school-based classroom intervention to reduce harmful substance use and violence, generally delivered to at-risk students in middle and/or high school (age range of approximately 11–18 years);

- Second Step is a classroom-based social skills curriculum for preschool through to junior year of high school (year 12 of schooling, age 16–17 years), with a distinct curriculum for each grade; and

- Responsive Classroom is a pedagogical approach focusing on how teachers both teach and interact with elementary school students (age range of approximately 6–11 years). It is designed to provide teachers with strategies, structures, practices and techniques to improve their self-efficacy, to impact student social and emotional, academic and non-academic outcomes and to build a strong school community.

The estimates of BCRs across the interventions ranged from 3.5 to 13.9, with a median of about ten and an average NPV per 100 participants of US$ 618 380 (Belfield et al., 2015, p46). The results are based on the development of SEL skills and how these skills influence future earnings. Belfield et al. (2015) proposed that these outcomes are mediated through changes in educational achievement and they established a framework for estimating the value of SEL skills in developed countries.

Major SEL intervention programmes have sought to address school connectedness by improving the school climate and providing comprehensive health promotion. These have included the Australian Gatehouse Project and the Indian SEHER programme covering 75 schools in Bihar, India.

The Gatehouse Project was developed to address some of the limitations in earlier school health promotion work, building on whole-school change programmes. The major aims were to increase levels of emotional well-being and reduce rates of substance use, known to be related to emotional well-being (Patton et al., 1998; Resnick et al., 1997).

The SEHER programme, when delivered by lay counsellors rather than teachers, "showed large effects on improving school climate and a range of health-related outcomes including depressive symptoms, bullying, violence, attitude towards gender equity and knowledge of reproductive and sexual health, compared with both the standard life skills intervention and the teacher-delivered intervention" (Shinde et al., 2018, p2466).

3.1.3 Peer connectedness

Peer connectedness is defined as perceptions of support, genuine caring and trust in one's peer group (Bernat and Resnick, 2009). Although they can sometimes be sources of pressure for antisocial behaviour, peers are often major influencers for pro-social behaviours (Resnick et al., 1997; Oldfield et al., 2016). Young people who have strong peer relationships have better social and emotional functioning than their more isolated age-mates (Oldfield et al., 2016).

Sports-based development programmes are assumed to promote socioemotional skills, improve psychological well-being and foster traits that boost labour force productivity. Beaman et al. (2021) partnered with an international non-governmental organization to randomly assign 1200 young adults in Liberia to a sports and life skills development programme. The study did not find any evidence of improved psychosocial outcomes or resilience. It did, however, find evidence that the programme caused a 0.12 standard deviation increase in labour force participation. Secondary analysis suggests that the effects are strongest among those likely to be most disadvantaged in the labour market.

One intervention programme, the Teen Connection Project, was created for high school students in the United States of America to help improve the quality of their peer relationships (Humphrey, 2022). For the intervention, students would meet in small groups for discussions guided by a trained facilitator. Over time, the initiative aimed to demonstrate to students that their peers could be healthy sources of support. Four months after the group sessions concluded, the students who received the intervention displayed lower levels of depressive symptoms and higher levels of academic engagement than control group members (Allen et al., 2021).

3.1.4 Community connectedness

Community connectedness reflects social cohesion. Adolescent perceptions of connectedness are measured by: neighbourhood safety; adult willingness to act if they see vandalism or criminal activity in the neighbourhood; the extent to which people in the neighbourhood look out for each other; a personal sense of belonging in the community; and having a voice in the community (Blum et al., 2022).

One successful programme is CTC, a multi-country programme originating in Washington state, United States of America. It has a five-step programme: get started get organized, develop a community profile, create a community action plan and implement and evaluate. Communities implementing CTC first complete five phases of training and an installation process over 12 to 18 months. The interventions are not pre-specified but left up to the communities to choose ones of particular local relevance.

Kuklinski et al. (2021) estimated the sustained impacts and long-term benefits and costs of the CTC prevention system. This was evaluated in a longitudinal cluster-randomized trial involving 24 communities in seven states within the United States of America. The study found that CTC had a statistically significant global effect on primary outcomes, and also on combined primary and secondary outcomes. A cost-benefit analysis provided estimates of net benefit per participant of US$ 7152, increasing to US$ 17 919 when secondary impacts (e.g., earnings) were included. While CTC has been evaluated as cost-effective, this was not an evaluation of any specific intervention since the selection of intervention(s) depended on local community choice. However, other studies have shown that community-driven development (White et al., 2018) had no impact on social cohesion or governance.

3.1.5 Review of the economic evaluation literature

The primary aim of the scoping reviews discussed in this chapter was to identify studies that reported full economic analyses such as benefit-cost, cost-effectiveness or other cost analyses relating to connectedness including social capital and social relations for adolescents. A search to identify peer-reviewed literature in any language was conducted in six databases (Medline, PubMed, CINAHL, PsychInfo, Cochrane Library, Web of Science) in accordance with the PRISMA guidelines, as well as a search of the TUFTS registry of cost-effective analysis studies.

Fifteen articles were identified: seven from the selected databases, two from the TUFTS registry and six from other sources (Open Grey Database, GoogleScholar.com and Google.com using keywords). Most were from HICs. Only two were from LMICs and LICs. Almost all the studies focussed their outcomes on deviant behaviour, such as harmful substance use and alcohol use, and five had a crime focus (four about recidivism). One study (Moodie et al., 2009) included consideration of school dropout and adult offending. A Ugandan study by Tozan et al. (2022) examined disruptive behaviour disorders and had a focus on interventions with family groups.

Thirteen studies (nine were based on RCTs) included an economic evaluation and the two other studies only reported economic costs. Dopp et al. (2014), for instance, undertook a benefit-cost study of multisystemic therapy for serious juvenile offenders, obtaining a BCR of 5.04 in savings to taxpayers and crime victims over 25 years.

In summary, the outcomes of the scoping review were that:

- studies with well-developed economic evaluations tended to be for narrow outcomes, such as harmful substance use, disruptive behaviours and criminal activity (four intervention programmes with cost-benefit analysis were focussed on recidivism);
- studies concentrated on adolescent problems rather than an assessment of preventive or promotive programmes;
- none examined how increased connectedness impacted employment; and
- studies tended to focus on males rather than females.

3.2 Agency and resilience

Agency has been described as multidimensional (Vijayaraghavan et al., 2022) and its interpretations can vary across contexts. Kabeer (1999) defined agency as "the capacity to make choices and the power to act on those choices, especially to claim and voice rights" (p439). It can assist an adolescent to conceptualize a goal and then work towards achieving it. Resilience is defined as the capacity to adapt to change or disruptions (Vidyarthi et al., 2021) and is associated with the characteristic of hardiness. Resilience does not so much imply an invulnerability to stress, but rather an ability to recover from negative events (Garmezy, 1991; Fonagy et al., 1994). An adolescent's resilience is determined by the extent of agency that they have.

Resilience can be anticipatory (the ability to prepare and avoid the impact of shocks), absorptive (the ability to absorb, cope with and buffer the impact of shocks), adaptive (the ability to adapt to future risks) and transformative (the ability to make changes that help reduce the underlying causes of risks) (Vidyarthi et al., 2021).

As with connectedness (Domain 2 of the Adolescent Well-being Framework), there have been some valuable studies on the role of agency and resilience in adolescent well-being over the past two decades, including both empirical work and programme development and implementation. Individual characteristics, as well as social and economic factors, affect a person's agency and resilience. Many programmes have been developed, and in some cases evaluated, to address these factors, as listed below:

- SEL programmes (discussed above under connectedness, but they have strong links to agency and resilience).

- Programmes, often with a focus on gender relations, such as Champions for Change (Plan International, 2023) and the Access, Services and Knowledge (ASK) (CIN, 2016) and Program H (Doyle and Kato-Wallace, 2021). These are discussed later in the chapter.

- For economic factors, UNICEF's UPSHIFT programme (UNICEF, 2023b) has been implemented in many countries.

- There are many multisectoral programmes, especially in Africa, such as the Adolescent Girls Initiative (Austrian et al., 2020), incorporating violence prevention, education, health and wealth creation. This initiative has been the subject of a cost-effectiveness evaluation.

- Singh et al. (2022) provide an evidence map of a range of interventions for women's empowerment in LMICs. These included economic interventions, capacity building interventions (such as LST, technical and vocational training, business training and information and communications technology [ICT] training). Several of the interventions have been included in our study, however, some are related to older women, not adolescents, and were therefore excluded.

- Maiorano et al. (2021) developed a method to measure empowerment, which includes a direct measurement of decision-making, defined as the ability to make choices; a measure of whether people have reasons to value those choices; and a measure of the role that prevailing social norms play in determining people's ability to make strategic life choices.

3.2.1 Factors affecting agency and resilience

A range of factors impact both agency and resilience. They can be affected by individual factors such as self-identity, which is determined by "their age, religion, ethnicity and sex, their sexual orientation, gender identity and expression (SOGIE), where they live and whether they are disabled" (Vidyarthi et al., 2021, p2); or by macro-level factors such as policies, laws, sociocultural norms and economic forces (Blum et al., 2014).

To have agency, an adolescent needs to possess: self-efficacy (belief in their capacities and ability to succeed); self-esteem (their overall sense of self-worth); a sense of mattering (feeling of being important/significant); and the experience of bodily autonomy (right to governance over one's body) in an environment free from all forms of gender-based violence (GBV) and discrimination. They also need to feel connected at home, in schools, with peers, in communities and online.

The self-identity of adolescents can be determined by deep-rooted social and gender norms (Ricker and Ashmore, 2020). Girls, in particular, have limited agency in contexts where females are not valued or social norms (such as child marriage) limit their potential to achieve agency. Girls, particularly in poor regions, may have truncated educational opportunities (UNFPA, 2012) or be regarded as economic commodities to settle familial debts or disputes (Parsons et al., 2015). Unequal power structures that limit an adolescent's choice and opportunities, including aspects such as gender norms, sexuality, mobility, participation and decision-making and access to and control over resources, limit the sense of self-identity and agency.

A range of factors have been identified as supporting resilient outcomes for adolescents across different sociological domains (Gartland et al., 2019). These include individual factors such as coping style, cognition, optimism and self-esteem (e.g., Ben-David and Jonson-Reid, 2017); positive family relationships and social connectedness within the family (Ben-David and Jonson-Reid, 2017; Marriott et al., 2014); and community factors, including social connectedness within the family (Fantuzzo et al., 2012).

Wilson et al. (2021) identified risk factors as including poverty, violence and marginalization while youth education was identified as a protective factor. Vidyarthi et al. (2021) included lack of parental involvement, bullying, violence and low self-esteem/self-image as risk factors. These can impact adolescents' cognitive, social and emotional development and negatively affect learning, competence and educational achievement. Vidyarthi et al. (2021) added that, as is the case with health and nutrition, there is a two-way link between education and agency and resilience. Saleem and Mevawala (2019) and Frankenberg et al. (2013) indicated that education is a protective factor that helps cultivate skills to enhance agency and resilience and plays a role in coping with disasters over the longer term. However, it is also acknowledged that education itself and education policies can lead to inequalities (UNICEF, 2016) and there is evidence that rising inequalities in education can increase the risk of conflict. Bullying can impact children's short- and long-term physical and emotional development, school performance and mental and physical health.

3.2.2 Interventions to improve agency and resilience

Individual factors

Interventions for individual factors include the provision of information, access to services, access to resources and those that help build social and emotional or non-cognitive skills and enhance SEL. The focus of SEL is on the process of acquiring the attitudes, competencies, knowledge and skills essential for learning, being effective and having a sense of well-being.

We have already noted the importance of social and emotional skills for a child's development, enabling them to respond appropriately to social interactions. These are often regarded as soft skills and personality traits. Heckman and colleagues have demonstrated the importance of cognitive and socioemotional factors, which they defined as traits such as conscientiousness, self-control and self-discipline (Heckman et al., 2014), in determining favourable educational and lifetime earnings outcomes (Heckman and Kautz, 2012).

The curriculum of Promoting Alternative Thinking Strategies (PATHS) aimed at elementary school children is an exemplar of school-based SEL programmes (Humphrey et al., 2018). PATHS teaches self-control, emotional awareness and social problem-solving skills. A recent meta-analysis shows that the programme improved grades by 0.33 standard deviations and achievement test scores by 0.27 standard deviations (Durlak et al., 2011).

Interventions for social factors

Some major interventions for addressing social factors include: Plan International's Champions of Change for Gender Equality and Girls' Rights programme, which is active in 41 countries, most of which are LICs and MICs, and aims to advance gender equality through youth engagement (Plan International, 2023); the Yes I Do programme of the Yes I Do Alliance, which aims to enable adolescent girls to decide if, when and with whom they marry and have children, and to protect them from FGM/cutting (Kakal et al., 2016; Yes I Do, 2018); and the ASK programme of the Youth Empowerment Alliance, which seeks to improve the SRH rights of young people (15–24 years) by increasing their uptake of SRH services in Kenya, Uganda, Ethiopia, Ghana, Senegal, Pakistan and Indonesia (CIN, 2016).

Other programmes include Program H (Doyle and Kato-Wallace, 2021), the Adolescent Girls' Initiative (AGI) (Austrian, et al., 2020), BRAC's Women's Empowerment programme in Uganda (Bandiera et al., 2020), Positive Youth Development programmes (Roth and Brooks-Gunn, 2016) and a programme to assist victims of the Lord Resistance Army suffering from post-traumatic stress (van Reisen et al., 2018). These are discussed briefly in turn.

Program H engages young men to help change gender norms related to masculinities that perpetuate gender inequality (Doyle and Kato-Wallace, 2021). The programme seeks to promote SRH rights and to prevent violence against women and girls. It is now used globally in around 36 countries and has been named best practice by the World Bank and WHO (Doyle and Kato-Wallace, 2021).

The Doyle and Kato-Wallace (2021) review of the evidence related to Program H included three RCTs, nine quasi-experimental designs and two pre-post evaluations (without a comparison group) with sample sizes ranging from 100 to more than 3000. Overall, the review found that Program H had produced positive changes in young men's gender attitudes in most, but not all settings. More gender-equitable attitudes

among participating young men were found in nine of the 14 studies reviewed. No costing or cost-benefit analysis was undertaken.

A study in Northern Uganda for victims of the Lord Resistance Army suffering from post-traumatic stress compared the effect on economic development of existing government-initiated social protection programmes (cash and in-kind) with a trauma counselling programme. The study found that the effect of the trauma counselling programme on income and social economic resilience was higher than the effect of the social protection programmes. The study had aimed to include a cost-benefit analysis but was unable to complete it (van Reisen et al., 2018).

The AGI–Kenya (AGI-K) programme comprised interventions that were delivered to over 6000 girls aged 11–15 years in two marginalized areas of Kenya (Kibera [urban] and Wajir [rural]). The interventions aimed to build social, education, health and economic assets for girls as well as improve household economic assets in the medium-term. This would lead to delayed childbearing in the longer term.

Austrian et al. (2020) described the four interventions of the AGI-K as follows:

- The Violence Prevention (V) intervention included community dialogues and action plans with a key group of adult stakeholders in each community meeting regularly to discuss the challenges facing girls in their area then developing and implementing a plan to address at least one of those challenges.

- The Education (E) intervention was a conditional cash transfer (CCT) that included a bimonthly payment to the household, direct payment of a portion of school fees and a schooling kit for the girls. All incentives were conditional on the girl's enrolment and regular attendance at school.

- The Health (H) intervention included weekly girls' group meetings or safe spaces facilitated by a young woman from the community, which covered a range of health and life-skills topics.

- The Wealth Creation (W) intervention included financial education (FE) within the group meetings as well as savings accounts in the urban site and home banks in the rural site.

In evaluating the effectiveness of the interventions, Austrian et al. (2020) found that in Kibera, at the end of the two-year intervention, girls in the three packages with CCT had improved rates of primary school completion and transition to secondary school. They had also improved outcomes in a range of SRH knowledge measures, although it did not affect the acceptability of intimate partner violence. In Wajir, the education results were similar but there was no significant impact on SRH knowledge.

A cost-effectiveness and benefits valuation study in Kibera indicated a monetary benefit of US$ 55 per girl and US$ 94 per out-of-school girl in Wajir. Kangwana et al. (2022) also studied the AGI–K intervention, quantifying favourable results for the programme.

BRAC's women's empowerment programme developed in Uganda included the provision of: hard vocational skills to enable adolescent girls to start small-scale income-generating activities and what are referred to as soft life skills to build knowledge, enabling girls to make informed choices about sex, reproduction and marriage. Bandiera et al. (2015) evaluated the programme and found that four years post-intervention, adolescent girls in treated communities that had received the programme were more likely to engage in income-generating activities and that teen pregnancy had fallen by a third. The study also provided the costs and benefits of the programme.

Catalano et al. (2018) systematically reviewed Positive Youth Development programmes in LMICs. Their study found that 60% of the 35 programmes with rigorous evaluation demonstrated at least one positive effect on behaviours, including harmful substance use and risky sexual activity and/or more distal developmental outcomes such as employment and health indicators.

3.3 Case study – connectedness, in search of economic evaluations of its impact

3.3.1 Introduction to case study

The Lancet Commission on Adolescent Health and Wellbeing recommended schools as a setting for promoting adolescent health and well-being (Patton et al., 2016). Broad-based programmes addressing connectedness have generally been school-based. These are variants of socioemotional learning

programmes that have included positive action, life skills and initiatives directed at changing the school climate to achieve a greater sense of belonging (Patton et al., 2000).

Given the difficulty of directly measuring the relationship between connectedness and economic outcomes, there are few evaluations of programmes addressing the economic implications of connectedness and certainly none for LICs or LMICs of which we are aware. One way of measuring this relationship is to use indirect methods, such as the potential links between connectedness and school climate, school climate and mental health measures and mental health and academic outcomes as a way of establishing measurable relationships between connectedness and other variables that can be evaluated from an economic perspective.

In developing this case study, we had two objectives. One was to identify the evidence for the impact of intervention programmes, such as socioemotional learning, on connectedness and school climate so as to improve mental health and education outcomes. The second was to use the results obtained by the SEHER study to estimate the costs and benefits of extending the SEHER study to the state of Bihar.

The SEHER study reported a substantial reduction in depression rates with an effect size of -1.19 arising from the intervention, but it did not attempt to estimate its economic implications through education outcomes or the monetized value of its health effects. For our study, first, we derived an estimate of the intrinsic value of the health effects through the reduction in disease burden as measured by DALYs. Second, we used the results of the meta-analyses of the outcome of SEL programmes (Durlak et al., 2011; Taylor et al., 2017; Corcoran et al., 2018) to estimate the likely impact on academic performance. Third, we modelled these effects to estimate the BCR for the SEHER intervention for Bihar, India.

3.3.2 School climate and connectedness

The SEHER study owes part of its design to the pioneering school-based Gatehouse Project aimed at improving school climate. The Gatehouse Project provided each school with an assessment of its school climate based on three targeted areas of social interaction: security, social connectedness and gaining positive regard through valued participation (Patton et al., 2000).

There are few studies of similar broad-based intervention programmes in LICs or LMICs linking connectedness to mental health and education outcomes. The SEHER programme is one of the few large-scale programmes examining the impact of an intervention to improve school climate on mental health outcomes.

SEHER programme

SEHER involved a three-arm RCT designed to assess the effectiveness of a multi-component whole-of-school intervention programme for grade nine students in government-run secondary schools in Bihar, India. The intervention programme was compared with the standard government-run, classroom-based life skills Adolescence Education Programme (AEP). In one intervention arm, the SEHER programme was conducted by classroom teachers while the other was run by lay counsellors. The programme run by lay counsellors was more effective. The teacher-run programme provided little improvement over the AEP (Shinde et al., 2018).

The programme ran for two years and was evaluated after eight and again at 17 months. The measured effects of the interventions after 17 months were significantly higher than after eight months.[4] Only the effects after 17 months are shown in Table 3.1.

The lay counsellor programme had a marked effect on the school climate (measured by the Beyond Blue School Climate Questionnaire), radically altering the relationships between students, teachers and the administration through a programme of meetings, workshops, speak-out boxes and a wall magazine as well as general assemblies conducted by the principal. The lay counsellor programme had a marked positive effect on school climate and depressive symptoms, attitude towards gender equity, knowledge of SRH and frequency of bullying as shown in Table 3.1.

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4. Except for knowledge of SRH which was marginally lower.

*Table 3.1 **Results from SEHER lay counsellor intervention after 17 months***

Outcomes	Adj. mean difference	Adj. mean difference 95% CI	Effect size SMD	Effect size 95% CI
School climate	7.33	6.60 to 8.06 p<0.001	2.33	1.97 to 2.50 p<0.001
Depressive symptoms	-4.64	-5.83 to -3.45 p<0.001	-1.19	-1.56 to -0.82 p<0.001
Attitude towards gender equity	1.02	0.65 to-1.40 p<0.001	0.53	0.27 to 0.79 p<0.001
Knowledge of SRH	0.28	0.09 to 0.48 p=0.004	0.15	0.03 to 0.26 p=0.016
Frequency of bullying	-2.77	-3.40 to -2.14 p<0.001	-2.22	-2.84 to -1.60 p<0.001

Notes: SMD is standard mean difference. CI is confidence interval. Source: Shinde et al. (2020).

The impact of the lay counsellor interventions on school climate was especially large (effect size = 2.33), indicative of the degree of change in the school's overall operations towards a more participatory environment. The effects on bullying (effect size = -2.22) and depressive symptoms (effect size = -1.19) were also significantly large.

A further study of the programme results sought to distinguish the mediating role of school climate on depressive symptoms, experience of bullying and perpetration of violence through three of its subcomponents (relationships at school, sense of belonging, commitment to academic achievement and participation in school events) in three separate models (Singla et al., 2021).

The study used path models and mediation software to estimate the impact of school climate on the three outcomes: depressive symptoms, experience of bullying and perpetration of violence. Each was found to have a good fit.

Overall, the results showed that:

A positive school climate, characterized by supportive and engaged relationships with teachers and peers and a sense of belonging and active participation, would lead to lower rates of depressive symptoms, experiences of bullying, and perpetration of violence. (Singla et al., 2021, p97)

While the impact on school climate and its impact on mental health was large and significant, the study did not extend to education outcomes. Studies that examine the relationship between connectedness or school climate and education outcomes are relatively rare. One such study is by Panayiotou et al. (2019), discussed in the next section.

Connectedness, school climate, mental health and education outcomes

Panayiotou et al. (2019) explored the linkages between socioemotional competence, school connectedness, mental health difficulties and academic achievement. The model showing these relationships is illustrated in Fig 3.1. The results are drawn from an RCT of a universal SEL intervention (PATHS) used to raise the socioemotional competencies of students aged 8–12 and test the impact on school connectedness and mental health difficulties as mediators for academic attainment. The results are complex. The interventions had a significant impact on both mental health issues and school connectedness. However, only mental health issues had a statistically significant path to academic attainment. The impact of school connectedness on academic performance was through mental health issues, which has a two-way relationship with school connectedness. The study suggested that a reduction in mental health difficulties was the sole mediator between the SEL interventions and academic attainment.

Fig. 3.1 Structural equation model
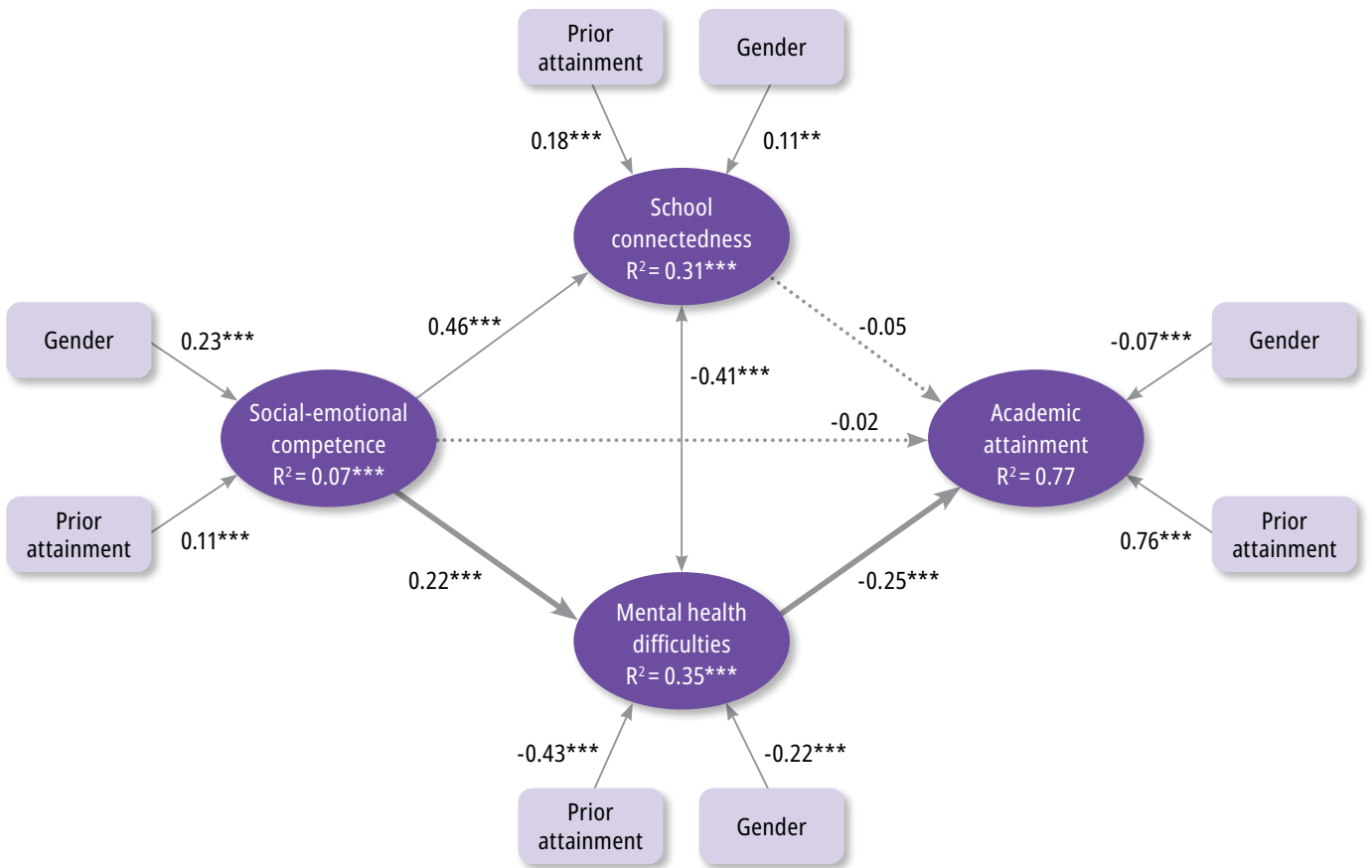
*Note***:** *Indirect effect, β = 0.05, p < 0.001, 95% CI [0.03, 0.08]. **p < 0.01, ***p < 0.001. Source: Panayiotou et al. (2019, p201).*

Both the Singla et al. (2021) study based on the SEHER intervention programme and Panayiotou et al. (2019) support the proposition that a favourable school climate has a beneficial effect on mental health outcomes. However, the Panayiotou et al. (2019) study also suggests a direct relationship between the interventions and mental health. This evidence suggests that the SEL programmes delivered in the SEHER project also, in all likelihood, had a positive impact on academic outcomes, but the project did not measure this.

The next section discusses the evidence for the relationship between SEL and education outcomes, employing the results of the structured reviews by Durlak et al. (2011), Taylor et al. (2017) and Corcoran et al. (2017).

Results of studies on the relationship between SEL interventions and academic outcomes

The characteristics and results of the three meta-analyses are summarized in Table 3.2. Each of the studies has demonstrated statistically significant positive outcomes in academic performance from the SEL intervention programmes.

The academic performance scores in the Durlak et al. (2011) study were based on standardized reading and mathematics achievement test scores. The results of eight follow-up studies found that after 150 weeks, the academic performance had been maintained with an effect size of 0.32. Some of the studies reviewed by Taylor et al. (2017) reported after long-term follow-up. This yielded an effect size of 0.12 for secondary school completion and 0.22 for college graduation. The Corcoran et al. (2018) study reported on academic outcomes with results of studies for mathematics, reading and science.

In summary, the results indicate effect sizes of between 0.25 (reading) and 0.33 (total sample). The average effect size of the studies weighted by the number of studies is 0.26, which is used in the cost-benefit analysis discussed in the next section.

*Table 3.2 **Effect size of SEL programmes on academic performance, results summary***

Study	# schools	# students		ES	CI 95%	N
Durlak et al. (2011)	213	270 034	Total sample	0.27	0.16 to 0.39	35
Taylor et al. (2017)	82	97 407	Total sample	0.33	0.17 to 0.49	8
Corcoran et al. (2018)	N/A	N/A	Reading	0.25	0.14 to 0.36	35
Maths				0.26	0.18 to 0.34	33
Science				0.19	0.05 to 0.33	5
Weighted average				**0.26**	**0.19 to 0.33**	**116**

Notes: ES = effect size (Hedges g). CI is confidence interval. For the WWC (2014), ES of 0.25 standard deviations or larger are considered substantively important, N = number of studies.

3.3.3 Cost-benefit analysis of the impact of SEL programmes on school connectedness

The evidence provided by the above analysis of the relevant literature suggests that SEL programmes with a focus on school climate could provide a causal link between school connectedness and mental health and education outcomes. While most of the studies providing evidence of these relationships are based on HICs, the SEHER study, conducted in the Indian state of Bihar (Shinde et al., 2020), provides a relatively unique opportunity to undertake a cost-benefit analysis for an LMIC.

The evidence for the relationships between SEL interventions, school climate, mental health outcomes and academic performance is both direct and indirect, as illustrated in Fig. 3.2. Fig. 3.2, captures the direct effects identified by Shinde et al. (2020) between the SEHER intervention programme and school climate and mental health components, bullying and depression. The indirect effects between SEL interventions and mental health components are mediated by school climate, as estimated by Singla et al. (2021) (shown in red). These are small but statistically significant.

These outcomes are supplemented by the results from the meta-analysis for the direct effect on academic performance summarized in Table 3.2 (effect size = 0.26) and the evidence provided by Panayiotou et al. (2019) of mental health issues on academic performance (effect size = 0.25). These latter two results are based on studies in HICs employing conventional SEL intervention programmes. Compared with many SEL programmes, the SEHER interventions have two enhancements. One is the employment of lay counsellors, and the other is the inclusion of school-wide interventions (Shinde et al., 2018; Singla et al., 2017).

Modelling methodology

Fig 3.2 suggests that a modelling methodology, which estimates the benefits of SEL interventions for improved adolescent mental health and academic performance mediated through school climate, could have two components. One could be based on the improved education outcomes and employment implications and the other on the value of mental health benefits.

While the evidence suggests complex interrelationships between school climate, mental health and academic outcomes, a simpler approach is to conduct the modelling in two parts. The first step is to analyse the relationship between the SEL interventions and education outcomes together with the estimates of economic benefits arising from the employment implications of better school performance. The second is to estimate the benefits of enhanced mental health arising from the SEL interventions and indirectly through improved school climate. The particular mental health conditions for which effect sizes are available are depression, bullying and violence. To estimate these mental health benefits, we converted the effect sizes to DALYs from GBD studies (IHME, 2019).

Given that a large proportion of the evidence was derived from a Bihar-based study, we situate the analysis in Bihar, employing demographics, school and economic parameters from Bihar.

Fig. 3.2 *Relationship between SEL interventions, school climate and academic performance, direct (purple) and indirect (orange) effects*
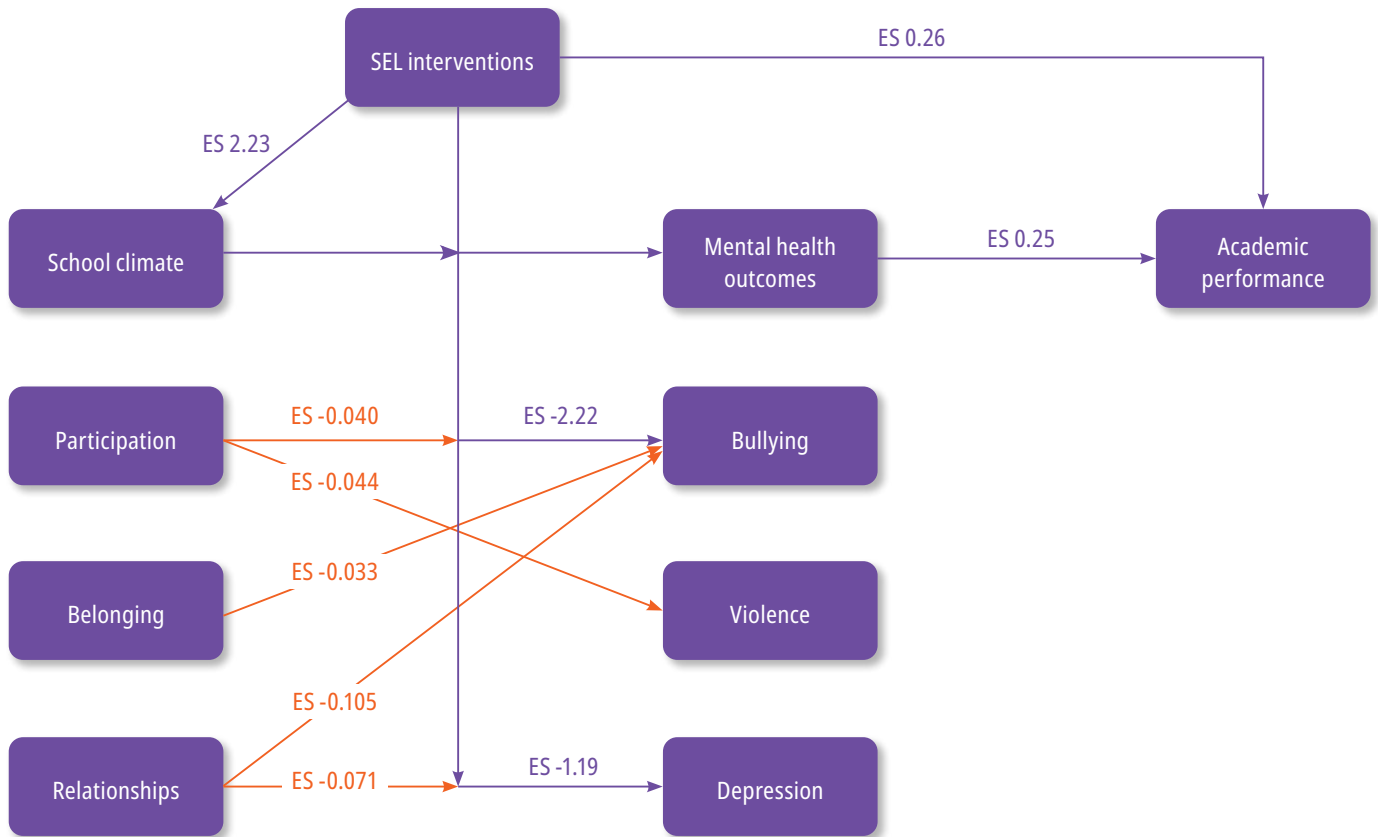
Sources: Developed from Shinde et al. (2018); Singla et al. (2021); Panayiotou et al. (2019, p201).

Results for the education and health effect of improvements in mental health in Bihar

Two effects were modelled: the intrinsic value of health and the productivity and earning gains due to improved academic performance and increased retention. The intrinsic value of the health effect was modelled through the impact on the disease burden of depression and bullying as measured by a reduction in the DALY rate. The Shinde et al. (2020) study reported that the effect size of the improved school climate on depression was -1.19 (CI 95% -1.56 to -0.82) and bullying -2.22 (-2.84 to -0.60) after 17 months. The results after only eight months were only --0.27 (-0.44 to- 0.11) for depression and -0.47 (-0.61 to -0.33) for bullying (Shinde et al. 2018). Indian DALY rates for depression and bullying for those aged 10–19 years were used as representative of Bihar to estimate the decline of depression and bullying in the Bihar secondary school population, which would occur should the SEL programme be progressively rolled out to all schools in Bihar. It was assumed that it would be administered each year with the results for the first assumed to be as measured at eight months and the second as measured at 17 months. For school leavers, it was assumed that the programme would have a positive effect on depression and anxiety (at the 2-year level) for 3.7 years (Taylor et al., 2017). Each DALY saved was valued at Indian GDP per capita in US dollars (Bihar GDP per capita not available) projected over the assumed period of the intervention to 2035, in accordance with current practice (Stelmach et al., 2022).

The intrinsic health effect for the period 2024 to 2050 was estimated in present value terms (3% discount rate) at US$ 1.93 billion. The estimated cost of the Bihar intervention programme was US$ 2.26 billion. For the health effects only, the BCR would be just under one (0.85) meaning that the estimated health benefits based on estimated DALYs saved would be somewhat less than the estimated costs. As discussed, the SEHER study did not attempt to measure the education effect of the intervention. To estimate a likely outcome for education performance for such an initiative applied to Bihar state, the education effect was

modelled using the VISES Education Model (VEM) (discussed in Chapter 6), assuming an effect size of 0.26 for SEL derived from the meta-analyses summarized in Table 3.2. This results in a reduced dropout rate of 3% and a reduction in what are known as learning gaps of 11%. The VEM applies assumptions about productivity gains from increased years of education and the likelihood of increased formal employment to those likely to successfully enter the workforce as a result of improved education outcomes. This results in an estimated earnings gain of US$ 55.9 billion in present value terms for the period to 2050, increasing to US$ 118.8 billion, again in present value terms, when the estimation of benefits is extended to 2100 (for example, at retirement).

The mental health benefits are added to these education benefits for a total of US$ 57.9 billion. This compares with the present value of the costs of the programme of US$ 2.26 billion for the period to 2050. On this basis, the estimated BCR is 25.6.

For the employment gains from participating in the SEHER programme, it can be reasonably assumed that a good proportion of school leavers will generate earnings until retirement. The duration of the impact of the SEL programme on mental health is much less clear. Taylor et al. (2017) referenced studies with an impact of up to almost four years.

3.3.4 Discussion

Programmes such as the Gatehouse Project and SEHER were initiated to address mental health issues for students in school. This would be achieved by improving the school climate and, with it, the connectedness of its students to school and their fellow students. The analysis presented in this chapter suggests that this strategy provides high returns relative to the costs of such programmes. However, it appears that the largest economic benefits arise from education rather than the health effects. This should not be surprising.

Gains through additional time spent in school and improved performance in school potentially deliver lifetime benefits in the form of better-paying and higher quality jobs. The mental health benefits of addressing depression and other issues have been assumed to only last a few years based on studies reported by Taylor et al. (2017). A recent paper by Bailey et al. (2023), however, reported that SEL has intergenerational effects. If it could be established that the intervention had a lifetime effect, this would increase the estimated value of the mental health benefits substantially.

The estimated health benefits may underestimate the broader consequences and therefore the benefit of the SEHER intervention programme. The estimated benefits are confined to only bullying and depression. This excludes other possible mental health effects. SEL programmes generally address a wider range of mental health issues, such as conduct disorder, which if quantified in the SEHER study may have generated a broader range of benefits than those quantified in this study. This study provides support for the concept of the school as a broad-based platform for the delivery of a range of interventions that do not have as their immediate objective narrow education outcomes, but which in fact, deliver substantial education and health benefits in a cost-effective way.

3.4 Conclusion

The purpose of this chapter, despite the challenges of quantifying the concepts of connectedness, agency and resilience, is to extend the existing literature to develop a case for investing in interventions to support improved outcomes in these domains. While the extension of the SEHER study is largely about connectedness, the links between these concepts and measurable outcomes that generate quantifiable economic benefits can support the case for increased investment in these areas, just as the case can be developed for health and education.

4. *Investing in adolescent mental health*[5]

4.1 Introduction

This chapter provides a detailed analysis of the quantitative assessment of programmes for the prevention and treatment of adolescent mental health.

As the WHO *World mental health report* (WHO, 2022a) pointed out, mental health conditions represent one of the leading causes of disease burden. This has remained so despite many of the same issues being raised and recommendations made two decades before (WHO, 2001). Even so, the approach to mental health care remains very much business as usual (WHO, 2022a) in the sense that most countries continue to rely on a biomedical and hospital-based service model.

For adolescents, public health consequences of mental health conditions are greater relative to the rest of the population. Mental health disorders represent 13% of the global adolescent burden of disease, as measured by DALYs (WHO, 2021a).

There are wide disparities in the burden of mental disorders between countries. Some possible reasons include income per capita and political instability/terrorism, which are significantly correlated with the level of mental disorders. Inequality and the level of youth unemployment also play a role (Viner et al., 2012). For adolescents in many countries, these structural determinants of mental health may have a very large impact on mental health outcomes. However, in formulating preventative interventions to address adolescent issues, it is the determinants much closer to home that are the focus of preventative intervention programmes.

Adverse childhood experiences can have a tremendous impact on future violence victimization and perpetration, and lifelong health and opportunity. They are linked to chronic health problems, mental health conditions and substance use problems in adolescence and adulthood. Adverse childhood experiences can also negatively impact education, job opportunities and earning potential (CDC, 2023). Reducing violence in early childhood can have lifelong benefits.

Connectedness to school is a powerful protective factor against mental health risks such as bullying and mental disorders, such as depression and anxiety (Patton, 2000; Bond et al., 2004; Shinde et al., 2018). School-based SEL programmes conducted by teachers or other trained staff are effective interventions for reducing depression and anxiety (Durlak et al., 2011; Taylor et al., 2017; Corcoran et al., 2018; Lee et al., 2023). Such interventions have been included in the recent WHO guidelines on mental health promotive and preventive interventions for adolescents (WHO, 2020a).

As noted earlier, social and emotional skills are being recognized increasingly as important for child development, providing support for their universal delivery. In evaluating SEL programmes, attempts are being made to capture mental health benefits, such as reductions in delinquency, conduct disorder, depression and anxiety; education benefits due to improved academic performance and enrolment retention; and direct earnings benefits through higher self-esteem and enhanced soft skills, as they are known (Belfield et al., 2015).

Belfield et al. (2015) is one of only a few benefit-cost studies of SEL programmes that have extended the estimation of benefits to education and direct earnings outcomes. This study is discussed further in section 4.4.1. Stelmach et al. (2022) conducted a more comprehensive cost-benefit analysis of the returns on investing in treating and preventing adolescent disorders, discussed in section 4.4.2.

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5. *Mental health interventions for anxiety, depression, psychosis, bipolar disorder, conduct disorder and harmful substance use are included in the OHT modelling reports, discussed in Chapter 2. They are listed in Table A2.2 in Annex 2. OHT does not include prevention interventions. In this chapter, we do address prevention.*

While treating conduct disorder and attention-deficit/hyperactivity disorder is a common objective of most SEL and other school-based programmes, there are cost-effective community-based programmes directed towards improving positive parenting and parenting competence to behavioural problems amongst adolescents. This includes the Connect Program in Sweden with a BCR of 10.61 (95%CI 10.29–10.93) (Nystrand et al., 2020).

Table 4.1 summarizes the results of investment evaluations employing cost-benefit analysis. They illustrate the generally high returns obtained by mental health interventions. The most comprehensive of the studies was conducted by Stelmach et al. (2022), which estimated a BCR of 23.6 for a wide-ranging group of interventions as well as a comprehensive set of benefits. Other studies have established a case for the economic value of targeted intervention programmes, such as SEL and harmful substance use. Other than the multi-country Stelmach et al. (2022) study, the results of the other studies listed in Table 4.1 were conducted in HICs, providing a poor guide to the investment case for mental health programmes in LICs and LMICs. However, the results from the SEHER programme conducted in Bihar, India, discussed in Chapter 3, support the effectiveness of school-based SEL-type intervention programmes in LMICs despite not including an investment evaluation.

Table 4.1 **Summary, BCRs for mental health interventions in adolescents**

Author	Location	Interventions	Benefits	BCR
Stelmach et al. (2022)	Multi-country (36)	Wide-ranging (teacher-led SEL-type, CBT, internet-based self-guided)	Comprehensive (health, productivity)	23.6
Belfield et al. (2015)	United States of America	SEL (life skill, 4Rs, SE training)	Reduced depression, bullying and education outcomes	3.5–13.9
Nystrand et al. (2020)	Sweden	Positive parenting and parenting competence	Improved adolescent behaviours	10.6
Spoth et al. (2002)	Mid-west United States of America	Parenting programme	Reduced harmful substance use	9.6, 5.85
Kuklinski et al. (2015)	United States of America	CTC programme	Reduced harmful substance use, delinquency, violence and other problem behaviours	8.2

Notes: BCR is benefit-cost ratio. SEL is social and emotional learning. CBT is cognitive behavioural therapy. 4Rs is the Program on Reading, Writing, Respect and Resolution. CTC is Communities that Care.

Mental disorders represent the largest health burden for adolescents. However, the application of known successful intervention programs with demonstrably high BCRs is limited in both LICs and HICs. The barriers to the adoption of universal programs through schools, for instance, are impediments that need to be addressed.

4.2 Importance of mental health

Mental disorders represent 13% of the adolescent GBD (WHO, 2021a). Fig 4.1 provides data on the GBD for adolescents classified by disease (tier 2). If suicide and harmful substance use are included, then the percentage would be increased to almost 17% of total disease burden (IHME, 2019).[6]

Expressed as a DALY rate (DALY per 100 000), the estimate for global mental disorders is 1384, which is almost twice as high as the DALY rate of the next highest causes, neurological disorders and skin diseases, which have DALY rates of 825 and 719, respectively. After that, the next highest is for a cluster of injuries, transport accidents and unintentional injuries, which together have a DALY rate of 1347. This is high but still lower than the rate for mental disorders.

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6. Suicide is dealt with separately in Chapter 7 of this report.

Fig. 4.1 *Adolescent* global burden by cause of disease, proportion of global disease burden, tier 2 classification level, 2019*

Mental disorders 12.9%	Skin and subcutaneous diseases 6.7%	Self-harm and IPV 6.1%	Nutritional deficiencies 4.7%	Musculoskeletal disorders 4.4%	Respiratory infections and tuberculosis 4.4%
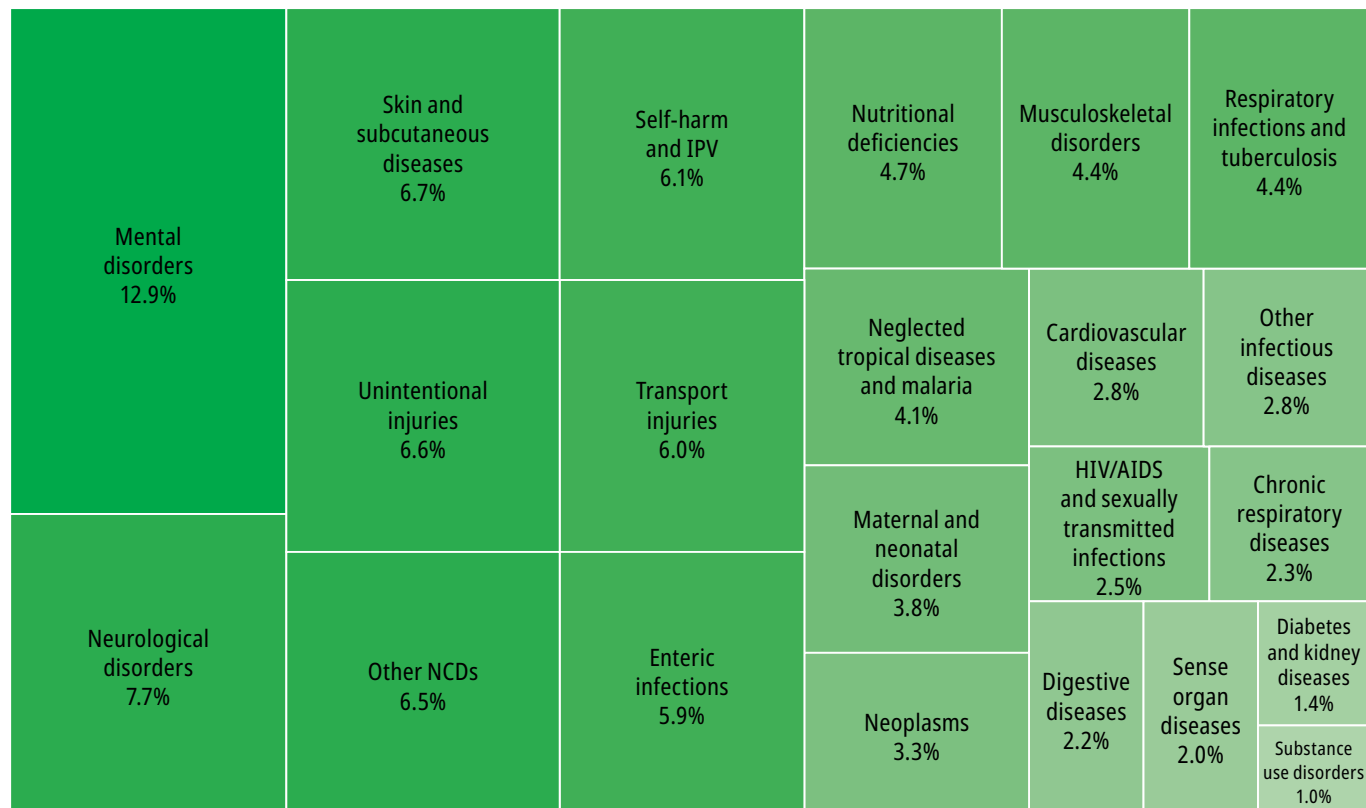
Notes: *Aged 10–19. ^Harmful substance use classified separately following GBD. Source: IHME (2019).

The disease burden of mental disorders, as measured by the DALY rate, is higher for females at 1440, than for males at 1331. However, this difference is less marked than for a number of other diseases. Fig 4.2 provides a comparison in terms of the DALY rate for mental disorders and a range of other causes of disease where the differences are much more marked (greater than 15% in the DALY rate). Neurological disorders, nutritional deficiencies and musculoskeletal disorders create a greater burden for girls while injuries from transport accidents, IPV and unintentional injuries in general have a greater impact on adolescent boys than girls.

Fig. 4.2 *DALY rates for the global adolescent (10–19 years) burden of disease by sex and selected cause, 2019*
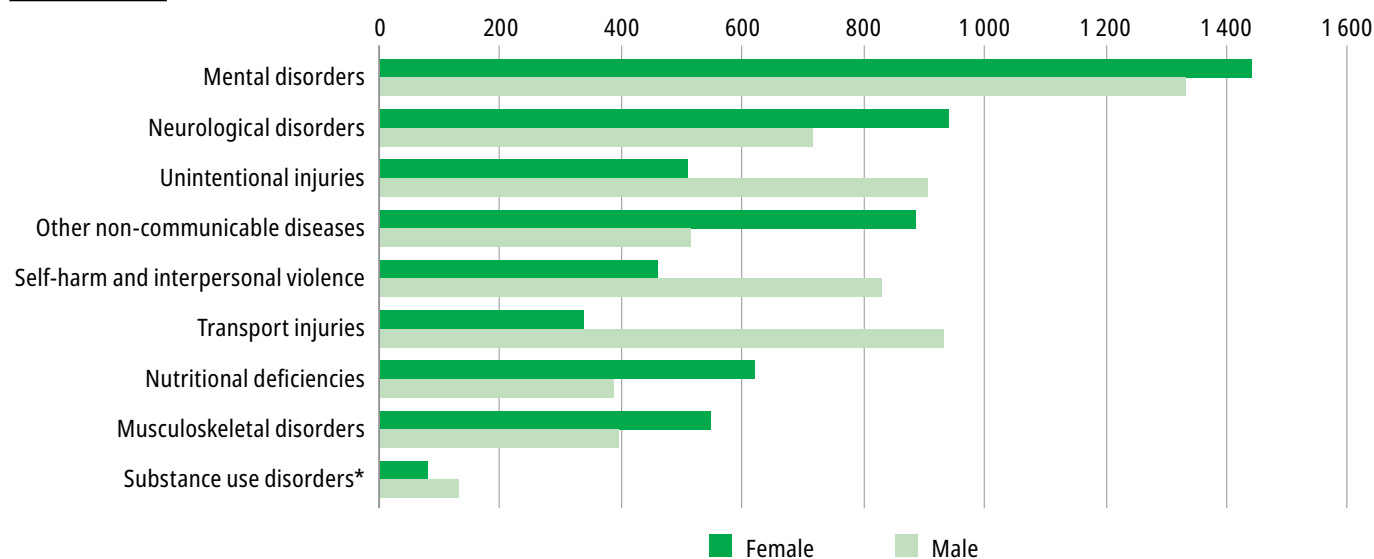
Note: *Harmful substance use classified separately following GBD. Source: IHME (2019).

4.3 Structural factors affecting mental health

Social determinants of health are analysed through structural factors such as national wealth, income inequality and access to education and those relating to families and communities, supportive schools and positive relations with peers (Viner et al., 2012). In general, adolescents who live in countries with high levels of country wealth, equitable levels of income distribution and which also have good education and accessible health systems, have better overall health outcomes. This appears not to be the case for adolescent mental health. The country-level GBD data permits analysis of the correlation between the level of adolescent mental disorders and macro socioeconomic variables at the national level, as detailed in the next section.

4.3.1 Country comparisons of mental health for adolescents

Income per capita

The GBD of mental disorders for adolescents is subject to wide country variation. The DALY rate ranges from a high of 2500 for New Zealand to 1018 for Viet Nam. Only a limited number of studies have attempted to explain these large country differences using macro socioeconomic variables (Öztürk et al., 2020), employed GDP per capita, unemployment and household debt to help explain the use of anti-depressants in nineteen HICs.

There is an association between country income per capita and mental health disease burden, as shown in Fig 4.3 for cross-country data for 202 countries, including HICs, MICs and LICs. It indicates that there is a reasonably strong correlation between the mental health disease burden and per capita income. A simple regression of the gross national income (GNI) per capita against the country DALY rate is significant at the 99% level.

Fig. 4.3 *Scatter diagram of adolescent mental health DALY rate (2019) versus GNI per capita (Atlas method), 202 countries, 2018*
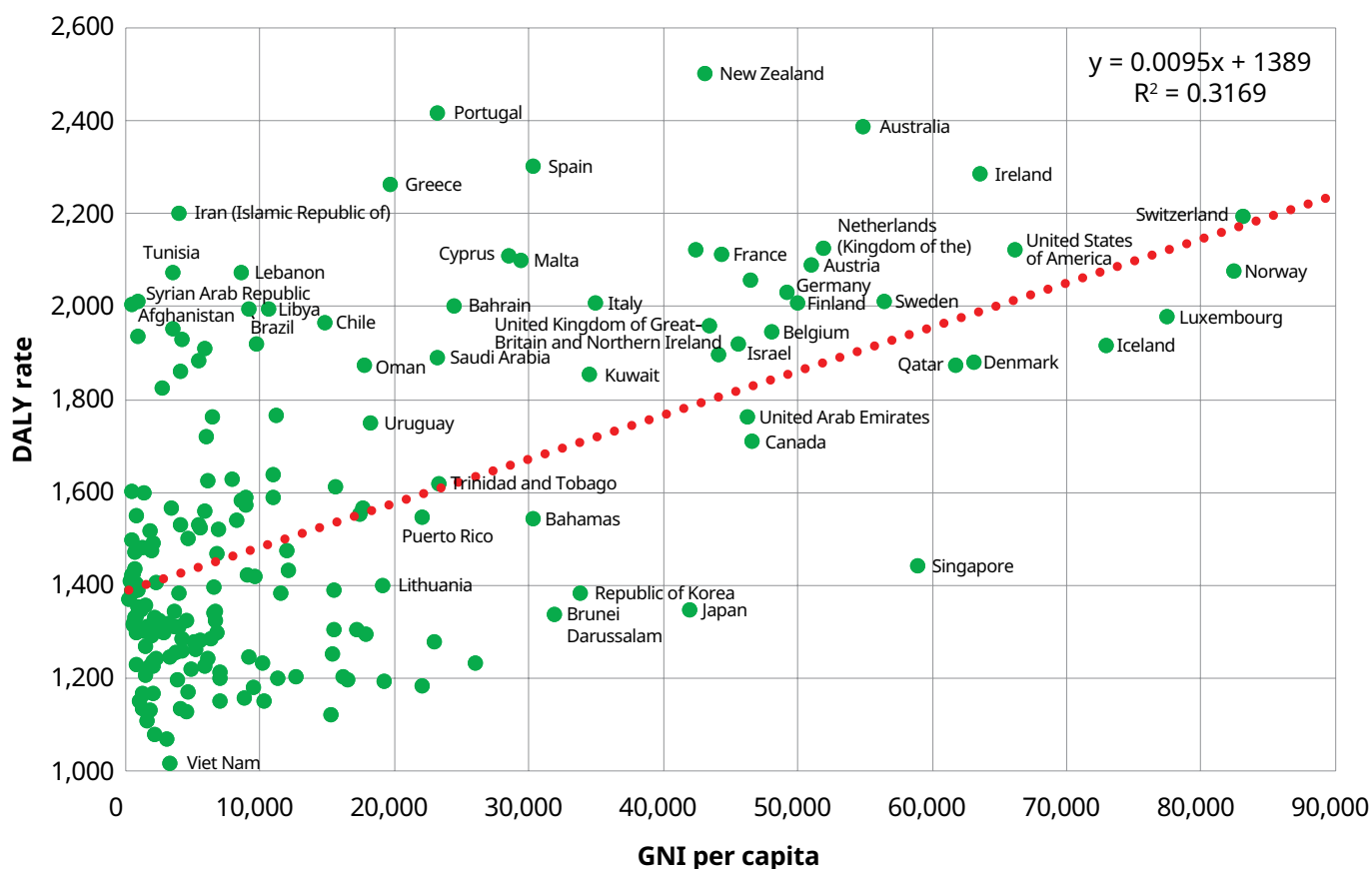
Sources: GBD data from IHME (2019); GNI per capita from World Development Indicators (World Bank, 2023c).

It is, however, counterintuitive that disease burden is higher for HICs. Some of the factors that are regarded as protective to mental health for adolescents, such as quality education and accessible health services, are more readily available in HICs. Indeed, the country with the highest measured adolescent mental health burden is New Zealand, which is noted for the quality and wide accessibility of both its education services and health system. Other HICs with high mental health DALY rates for adolescents (above 2000) include Finland, Netherlands (Kingdom of the), Norway, Sweden, Switzerland and the United States of America.

Overall, the main cause for the higher DALY rates for HICs is due to much higher levels of anxiety and depression disorders compared with LICs. Fig 4.4 shows average (unweighted) DALY rates for each country by income group. The average DALY rate for HICs is 1777 compared with 1420 for the remaining countries. Most of this difference is explained by the higher levels of anxiety (144) and depression (70). Eating disorders are also markedly higher in HICs.

Fig. 4.4 *Adolescent* mental disorders by type, DALY rate, 202 countries, 2019*
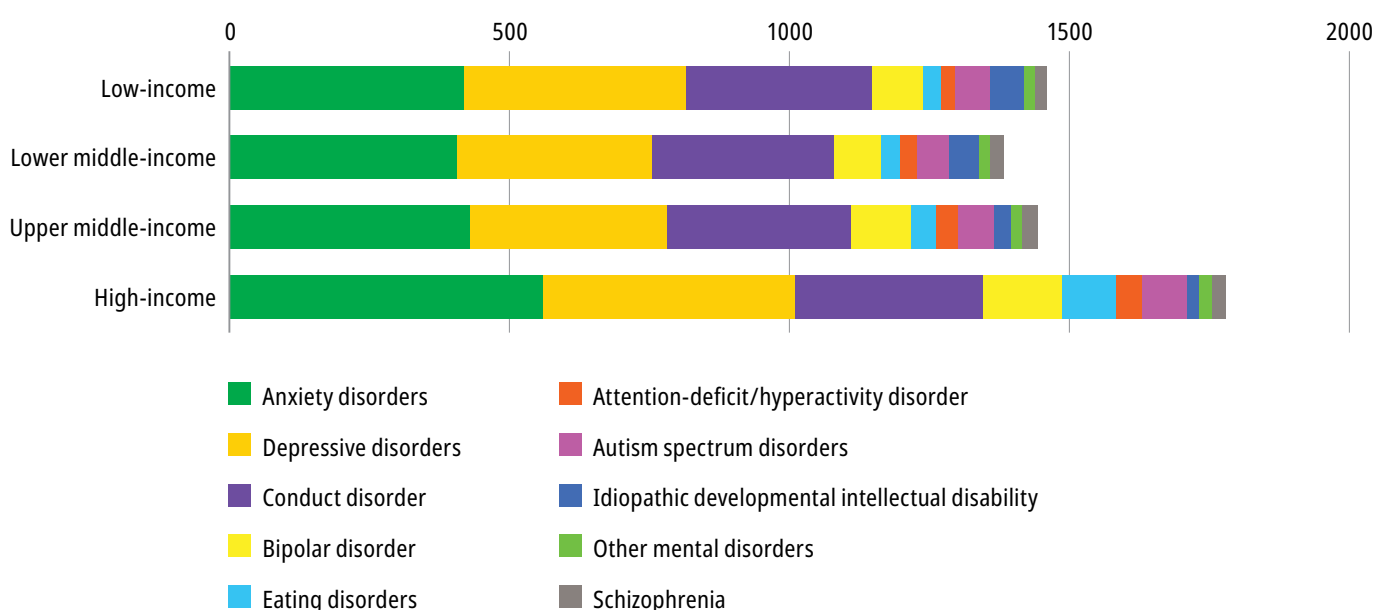
Note: *Aged 10–19. Source: IHME (2019).

Other factors suggested to explain high mental disorder DALY rates for mental health in HICs discussed in the literature (Viner et al., 2012) include income inequality and limited youth employment opportunities. However, analysis of country-level indicators suggests a relatively low correlation between mental disorder DALY rates for adolescents and variables such as the Gini coefficient, a widely accepted measure of income inequality (World Bank, 2023b).

Contrary to expectations (Viner et al., 2012; WHO, 2022a), at the national level, in this data set, there is little correlation between youth unemployment and mental disorders for HICs and UMICs. However, the coefficient is statistically significant for LICs and LMICs (t=4.9, p=<0.001). The correlation is particularly strong for LICs, as shown in Fig. 4.5 with an R^2 of 0.398. This suggests that for LICs, the rate of youth unemployment explains a significant percentage of the level of mental disorders, largely depression and anxiety. One other characteristic of note in Fig. 4.5 is that the vast majority of LICs had relatively low levels of both youth unemployment and mental disorders. In most LICs where work of any kind, including on family farms and in micro-businesses, is necessary for survival, unemployment is low and family connectedness is high.

However, these lower recorded levels of mental disorders in LICs may also be due to shortcomings in the data. Erskine et al. (2017) have drawn attention to the relatively small number of studies on which the GBD mental health data is based for many LICs and MICs. Moreover, concern has been expressed about methodological factors, such as the need to pay attention to cultural differences in the survey instruments (Baxter et al., 2013).

Moreover, in countries without a culture or language to describe mental disorders, even the appreciation that an individual's experiences might reflect an illness to be addressed may not occur to someone feeling sadness. There are deep-seated cultural beliefs about the causes of mental disorders that are a barrier to modern psychiatric care (Sorketti et al., 2013) with competition from faith healers (Ikwuka et al., 2016) and family counsellors (Bwanika et al., 2022). The stigma attached to mental illness in LICs and the limited facilities available reduces the propensity of sufferers to present for treatment (Whiteford et al., 2013; Saxena et al., 2007).

Fig. 4.5 *Scatter diagram of adolescent mental health DALY rate versus youth unemployment rate, 26 LICs, 2019*

$$y = 15.912x + 1316.4$$
$$R^2 = 0.3976$$
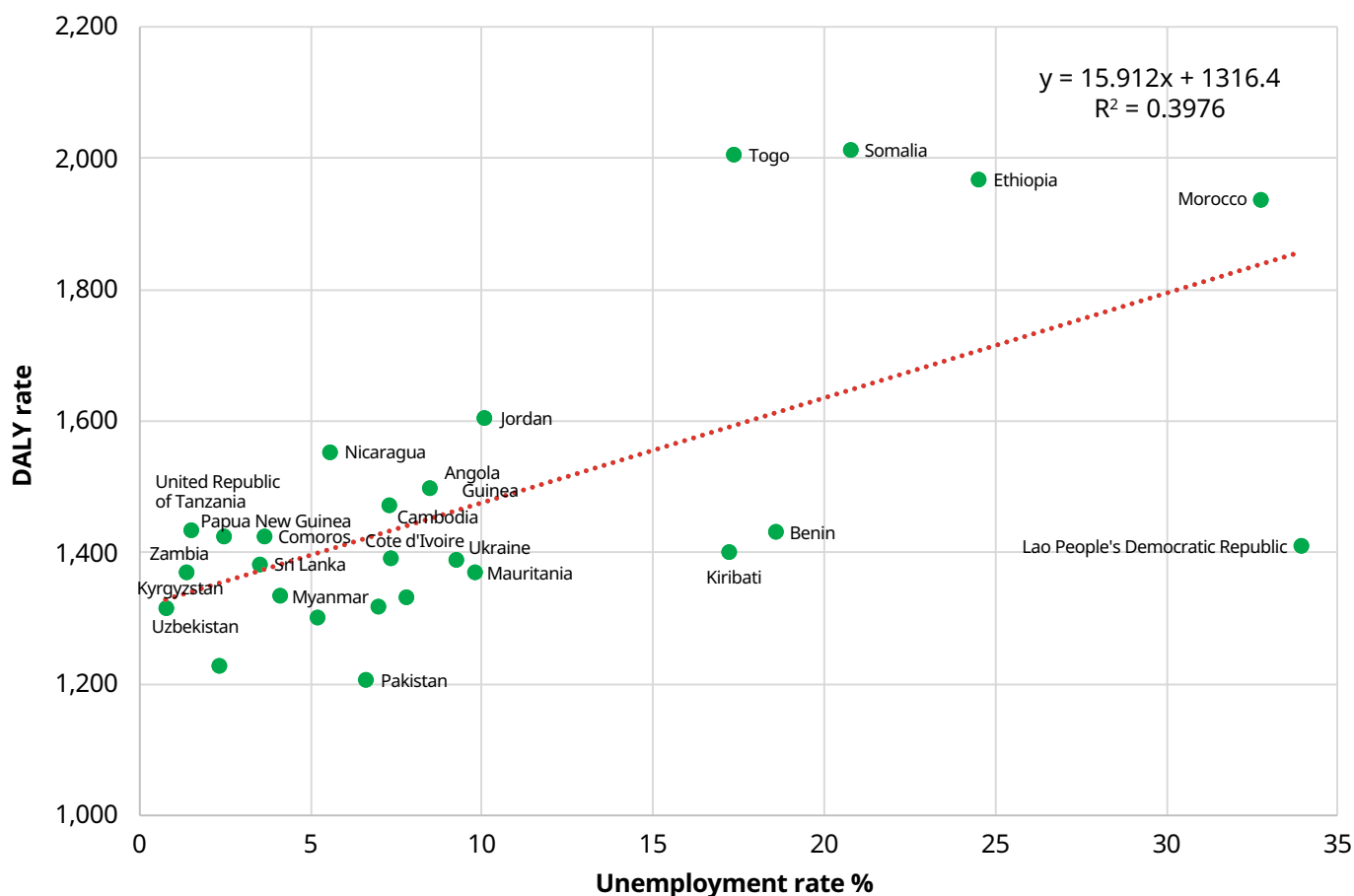
Sources: IHME (2019); World Development Indicators (World Bank, 2023c).

4.3.2 Political instability/conflict

There has been significant interest in the impacts of war and conflict on mental health (Lopez-Ibor et al., 2005; UNICEF, 2005, 2021). A few studies have documented the impacts of war by country (Murthy and Lakshminarayana, 2006; WHO, 2003; Baingana et al., 2005; Charlson et al. 2019) provided new estimates of the prevalence of mental disorders in conflict settings, which showed that age-standardized years lived with disability (YLDs) for conflict-affected populations was substantially higher than the global average. For instance, they estimated age-standardized YLDs for depression in conflict-affected populations at a rate of 24.8 YLDs per 1000 population (95% UI16.4–36.0) in contrast to the GBD 2016 global age-standardized estimate of 4.6 YLDs per 1000 population (3.2–6.2) (p245).

The development of the Political Stability and Absence of Violence/Terrorism index, published by the World Bank as one of its World Development Indicators (Kaufman et al., 2010), provides an opportunity to examine the relationship between the severity of mental disorders and the intensity of political instability/conflict at the global level.

A scatter diagram (Fig. 4.6) of the two indicators shows that while there is much variability in the relationship,[7] the overall trend is that mental disorder is positively associated with political instability/terrorism. In particular, there are a number of countries with high levels of political instability/terrorism that are amongst those with the highest mental disorder rates. These include Afghanistan, Iran (Islamic Republic of), Lebanon, Syrian Arab Republic and Yemen, which have all recently experienced civil wars, other violent conflict or governance failure. Moreover, they are neighbouring countries with similar problems and large adolescent populations (more than twice the proportion of HICs) with limited opportunities. They are also unstable countries with low levels of reported mental disorders, thus creating measurement issues, as previously discussed. The scatter chart is, therefore, indicative of the relationship between mental disorders and political instability, not conclusive.

Fig. 4.6 *Scatter diagram of adolescent mental health, DALY rate, versus political instability/ terrorism, 193 countries, 2019*
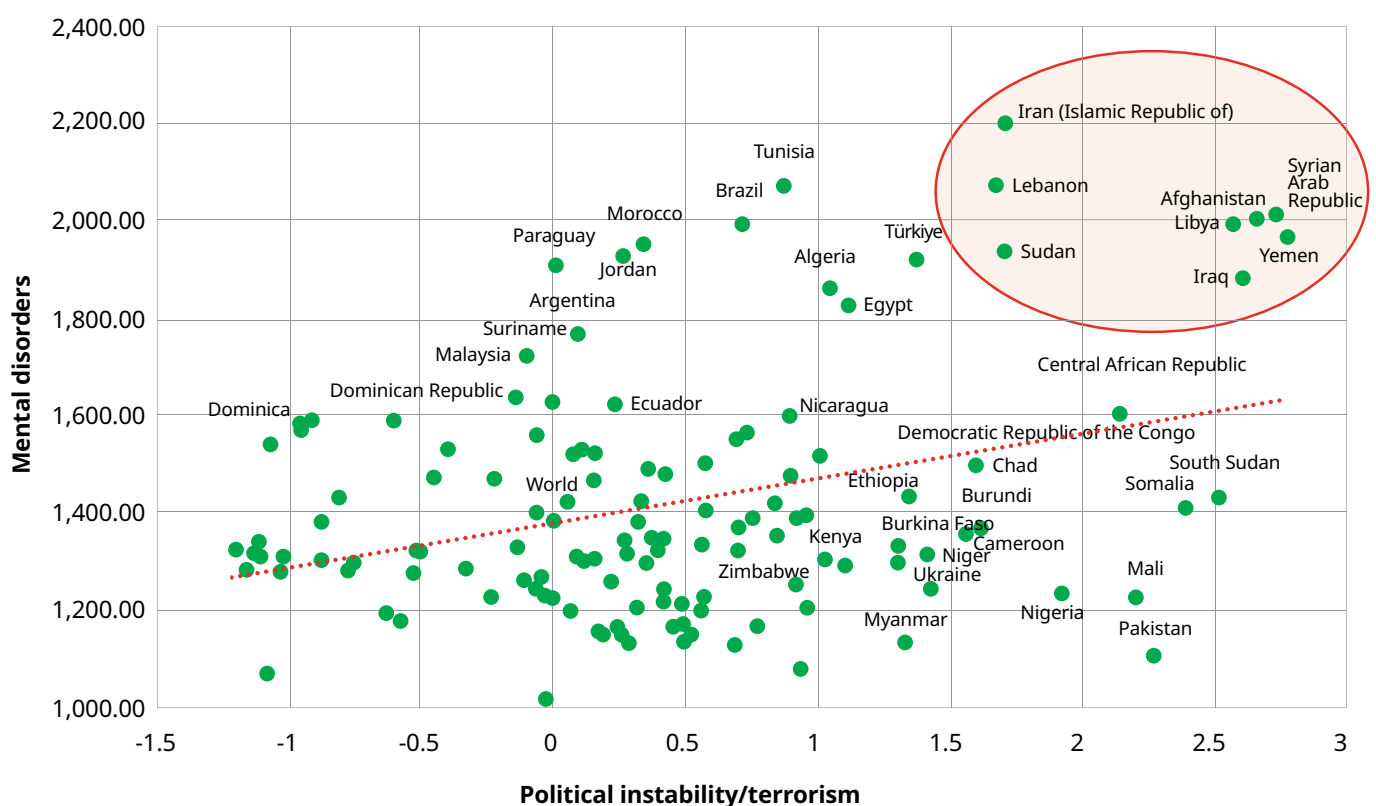
Sources: GBD data (IHME, 2019); Political Stability and Absence of Violence/Terrorism Index (Kaufman et al., 2010).

The broader issue of the impact of violence and terrorism on mental health and well-being is taken up at both the country and local levels in Chapter 7.

This analysis has demonstrated the wide disparities in the burden of mental disorders between countries and some possible reasons for these differences. The three areas analysed here (youth unemployment in LICs, income per capita and political instability/terrorism) are significantly correlated with the level of mental disorders. For adolescents in many countries, these structural determinants of mental health may have a very large impact on mental health outcomes. While these issues are beyond the scope of most intervention programmes, it does emphasize the need for existing programmes to be applied more intensely in low-income and politically unstable contexts where violence and economic instability seriously degrade the well-being of adolescents and the communities in which they live.

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7. *The relationship shows signs of heteroscedasticity, so the increasing spread of data either side of the trend line may be a product of measurement problems.*

4.3.3 Harmful substance use

Harmful substance use refers to excessive use of a drug in a way that is detrimental to self, society or both. It can also be termed substance use disorder. Substance use disorders are when use of a substance is heavy, prolonged and creates personal or social problems (Health Direct, 2023). Substance use disorder is a recognized medical brain disorder that refers to the use of illegal substances, such as marijuana, heroin, cocaine or methamphetamine as well as legal substances, such as alcohol, nicotine or prescription medicines. Alcohol is the most common legal drug associated with substance use disorder (John Hopkins Medicine, n.d.).

The GBD database provides an estimate of the worldwide prevalence of alcohol and drug use disorders as being 10.4 million adolescents (10–19-year-olds). The disease burden of harmful substance use is estimated by GBD as 107 DALYs per 100 000 with 132 for males and 80 for females. As with mental disorders, the country DALY rate is highly correlated with GDP per capita. Indeed, a number of HICs, including Canada, the United Kingdom of Great Britain and Northern Ireland and the United States of America, have especially high disease burdens from harmful substance use. The rate for the United States of America, for instance, is 805 and that for Canada is 594, both well above the global average.

WHO (2022b) also indicates that adolescent harmful substance use has wide disease and injury implications, as well as intergenerational effects. The harmful use of alcohol is a causal factor in more than 200 disease and injury conditions. Worldwide, three million deaths every year result from harmful use of alcohol.

In terms of the impacts of tobacco, WHO (2023b) states that: the tobacco epidemic is one of the biggest public health threats facing the world, killing over eight million people a year around the world; and the substantial economic costs of tobacco use include significant health care costs for treating the diseases caused by tobacco use, as well as the lost human capital that results from tobacco-attributable morbidity and mortality.

Harmful substance use is both a cause of and a response to other mental disorders. The proximal determinants of harmful substance use and the interventions to address it have much in common and significantly overlap with depression, anxiety and other mental disorders. These are discussed in the next section.

In formulating preventative interventions to address adolescent mental health issues, it is the determinants much closer to home, rather than generalized structural determinants, that are the focus of preventative intervention programmes. These are also discussed in the next section.

4.4 Proximal determinants

Most studies of the causes of poor mental health in adolescents focus on the individual, the community in which they live and the school they attend. These proximal determinants form the basis of intervention programmes typically focused on family, school, peer and broader community relationships.

While the provision of education services is an important aspect of the structural factors determining mental health outcomes for adolescents, so is the role of the school environment (Viner et al., 2012; Sawyer et al., 2021). As discussed in Chapter 3, connectedness to school is a powerful protective factor against mental health risks such as bullying and mental disorders including depression and anxiety (Patton, 2000; Bond et al., 2004; Shinde et al., 2018; Raniti et al., 2022).

4.4.1 Social and emotional learning

SEL programmes are not homogeneous, each incorporating different components depending on school objectives and circumstances. Most programmes incorporate both skills—behavioural and other mental health objectives—but their relative emphases may vary. The objective of some is to reduce depression and anxiety while others have a focus on delinquency, conduct disorders and reducing harmful substance use. Others, such as Responsive Classroom, have a greater focus on improved academic achievement (Belfield et al., 2015). This variability may lead to evaluation challenges and inconsistencies.

However, there are two main categories of SEL interventions: universal, which are delivered to all of the relevant population and indicated, which are delivered only to those who have been screened and found to be high risk.

Social and emotional skills are often regarded as personality traits that, according to Heckman and Kautz (2012), predict success in school, the labour market and in life. SEL is often embedded into a school curriculum and is seen to help reduce risky behaviours, such as violence and drug abuse (Durlak et al., 2011; CASEL, 2003). It may form one aspect of programmes designed to enhance non-cognitive skills and improve, among other things, academic performance (Gutman and Schoon, 2013b).

Zins, Bloodworth et al. (2004) sought to examine the relationship between SEL and school success as measured by school attitudes (e.g., motivation and responsibility), school behaviour (e.g., engagement, attendance, and study habits) and school performance (e.g., grades, subject mastery and test performance) (p194). A CASEL (2003) review of 80 nationally available programmes found that 83% produced academic gains.

As noted in Chapter 1, when evaluating SEL programmes, attempts are being made to capture mental health benefits, education benefits and direct earnings benefits. A recent study by Lee et al. (2023) focused on the mental health benefits of SEL. Their research presents a cost-effectiveness analysis of universal and indicated school-based SEL programmes designed to prevent the onset of depression/anxiety and suicide deaths amongst adolescents in 20 countries. The findings suggest that universal programmes are more cost-effective than indicated programmes. The cost of the programmes ranged from US$ 0.10 per capita for LLMICs to US$ 0.16 for UMHICs for the universal programmes, which converted to a cost of US$ 958 per HLYG to US$ 2006 per HLGY for UMHICs. This is compared to a cost of only US$ 0.06 per capita among LLMICs to US$ 0.09 per capita among UMHICs of the indicated programme, but the cost per HLYG was considerably higher at US$ 11 123 and US$ 18 473, respectively.

This demonstrates that the universal programme was much more cost-effective in both LLMICs and UMHICs. The costs were based on WHO CHOICE estimates and the interventions on a meta-analysis by Skeen et al. (2019), which reported effect sizes of -0.10 standard mean difference (SMD) and -0.19 SMD for universal and indicated, respectively. The interventions in the meta-analysis were varied, including cognitive and interpersonal therapy, yoga-based, mindfulness, empowerment and optimism programmes. The modelling of benefits was exclusively focused on improvements to health, and did not include any productivity gains from the reduction in depression and anxiety or gains from other potentially beneficial effects.

As noted earlier, a small number of benefit-cost studies of SEL programmes have extended the estimation of benefits to education and direct earnings outcomes. Belfield et al. (2015) have estimated benefits and costs for a number of relatively well-known United States of America SEL programmes, which include 4R, Positive Action, LST, Second Step, Responsive Classroom and a Swedish Social and Emotional Training programme. These programmes address a wide range of adolescent social and emotional issues and include delinquency, aggression, bullying and harmful substance use as well as academic behaviours and achievement. Many of the benefits are calculated based on costs avoided, such as community costs of delinquency. Other benefits include earnings gains from improved academic performance. The programmes yield BCRs ranging from 3.5 for LST to 13.9 for socioemotional training, with a median of 10.

4.4.2 Social and emotional learning and beyond

Stelmach et al. (2022) conducted a more comprehensive cost-benefit analysis of the returns to investing in treating and preventing adolescent disorders. This study involved 36 countries and provided results for 11 interventions by World Bank income group, WHO region, age and sex. The largest net benefits were derived from a SEL-like school-based prevention programme for anxiety and depression.

Stelmach et al.'s (2022) model includes health effects, education attainment and impact on lifetime earnings. The interventions address anxiety, depression, bipolar disorder and suicide. For depression and anxiety, the interventions are for universal preventative programmes with the exception of one indicated preventative programme for mild depression. The interventions were drawn from the literature and best practice guidelines, such as the WHO mhGAP intervention guide (2016a). They include CBT, internet-based guided and self-help programmes and school-based programmes for anxiety and depression. The effect sizes are taken largely from studies for HICs but were assumed to be applicable to LICs and LMICs.

The overall result of the modelling was a BCR of 23.6, which includes both improved health and long-term benefits from higher educational attainment (years of schooling) and higher lifetime wages. An allowance was also made in the modelling for increased productivity from reduced absenteeism.

This suggests that investment in a range of mental health intervention programmes in LICs and LMICs should produce sizeable economic gains compared with the relatively modest investment required.

4.4.3 Community-based programmes for parents

While preventing conduct disorder and attention-deficit hyperactivity disorder (ADHD) is a common objective of most SEL and other school-based programmes, there are cost-effective community-based programmes directed towards improving positive parenting and parenting competence in addressing adolescent behavioural problems. Programmes include the Triple P (Mihalopoulos et al., 2007; Sampaio et al., 2018), Connect (Moretti et al., 2017) and Strengthening Families Program for Parents and Youth, 10–14 years (SFP 10–14) (Aos et al., 2004). One study by Lindsay and Strand (2013) has systematically evaluated four programmes for parents: Incredible Years; SFP 10–14; Strengthening Families, Strengthening Communities; and Triple P for children (8–13 years).

Nystrand et al. (2020) undertook a cost-benefit study of the four most widespread programmes used in Sweden based on an evaluation by Stattin et al. (2015). These were: Comet (Kling et al., 2010), Cope (Cunningham, 2005), Incredible Years (Webster-Stratton et al., 2004) and Connect (Moretti et al., 2004). Connect, a preventative programme based on attachment theory, instructed parents in strategies to deal with adolescent behaviours through role play and evaluation. It was the largest of the four. The BCR for the programme was 10.61 (95%CI 10.29-10.93) (Nystrand et al., 2020, p309). The model developed by Nystrand et al. (2020) evaluated the long-term economic consequences of the prevention of behavioural problems due to reduced dropout risk (Erskine et al., 2016). The model estimated increased earnings from completing secondary school based on Hultkrantz et al. (2017).

The other three programmes (Comet, Cope, and Incredible Years), which were based on social learning theory (positive reinforcement and praise), had varying effectiveness in improving parental performance and reducing behavioural problems, but delivered BCRs in the range of 6 to 16 using the same model.

4.4.4 Harmful substance use – community and parent-based intervention programmes

Accidental and intentional fatalities that are associated with drug and alcohol use in the adolescent population have been known for many years as one of the leading preventable causes of death for those aged 15–24 (NCHS, 1992; Schwartz et al., 1986; Smith et al., 1989). Moreover, adolescents using alcohol and other drugs carry a higher risk of school underachievement, delinquency, teenage pregnancy and depression (Cornelius et al., 1995).

Studies of interventions with rate of return analysis

McRae et al. (2001) indicated that a better understanding of behavioural processes, motivational issues and processes of behavioural change have helped develop effective psychosocial treatments. As harmful substance use is seen to be caused by both genetic and family environmental factors, many of the interventions to prevent harmful substance use are family-focused.

Spoth et al. (2002) studied the cost-effectiveness of two interventions: the Iowa Strengthening Families Program (an earlier version of the SFP 10–14), a seven-session intervention with parents and students together, and Preparing for the Drug Free Years (PDFY), a five-session intervention focusing primarily on parents. The study found that conservative estimates for the Iowa Strengthening Families intervention had a cost-effectiveness figure of US$ 12 459 per case prevented, a BCR of US$ 9.60 per dollar invested and a net benefit of US$ 5923 per family. For PDFY, estimates were a cost-effectiveness of US$ 20 439 per case prevented, a BCR of US$ 5.85 per dollar invested, and a net benefit of US$ 2697 per family.

A study by Kuklinski et al. (2015) concluded that the CTC programme to reduce youth harmful substance use, delinquency, violence and other problem behaviours was a cost-beneficial intervention. The study involving a longitudinal panel of 4407 youth, included 24 towns in seven states in the United States of America, matched in pairs within states and randomly assigned to the intervention to assess the costs and benefits of the programme. The programme sought to improve the collaboration and action among community stakeholders, strengthening community norms and increasing the adoption and implementation of evidence-based programmes (Hawkins et al., 2002). The study estimated that the programme produced US$ 4477 in benefits per youth (discounted 2011 dollars), at a cost of US$ 556 per youth to implement the programme for five years. The BCR was US$ 8.22 per dollar invested and the net present benefit was US$ 3920.

Kuklinski et al. (2021) estimated the sustained impacts and long-term benefits and costs of the CTC programme with a follow-up 12 years later. The study found that there were improvements in lifetime abstinence from harmful substance use and an increase in four-year college completions of 1.9%; a 20% relative improvement. Although CTC had small, sustained effects through to age 23, cost-benefit analyses indicated CTC was reliably cost beneficial with an NPV of US$ 7152 (95% credible interval: US$ 1253 to US$ 15 268) per participant from primary impacts and US$ 17 919 (US$ 306 to US$ 39 186) when secondary impacts were also included.

Van Ryzin et al. (2023) estimated the costs and benefits of cooperative learning (CL), a universal school-based approach to adolescent substance use prevention. CL focuses on interrupting the process of deviant peer clustering and providing at-risk youth with the opportunity to build social skills and cultivate friendships with low-risk youth. The study used four waves of data from a cluster-randomized trial (N = 15 middle schools, 1890 students, 47.1% female, 75.2% white, 13.9% of students were receiving special education services) and found that significantly lower percentages of students in the CL intervention schools became regular users of tobacco, alcohol and marijuana. The study estimated that the reduction in substance use associated with the implementation of CL resulted in total lifetime benefits of between US$ 1027 and US$ 4621 per student (in 2019 dollars), or between US$ 8.79 and US$ 39.54 for each dollar invested in CL. BCRs would go up by US$ 22.54 to US$ 101.39 per dollar invested with the continual implementation of CL, assuming retraining every five years.

4.5 Conclusion

Mental disorders represent the largest burden of disease for adolescents. However, there is significant measured variation between countries, depending on, among other structural factors, GNI per capita, youth unemployment and political instability.

The interventions to address mental disorders experienced by adolescents include prevention programmes, such as SEL, and treatment programmes, such as CBT. They range from classroom interventions to individually delivered programmes in-person and, increasingly, successful interventions via the internet.

Of the intervention programmes, those that have been evaluated in the literature using cost-benefit analysis include SEL with BCRs ranging from 3.5 to 13.9 (Belfield et al., 2015), parenting programmes with a BCR of 10.6 (Nystrand et al., 2020) and the CTC harmful substance use programme with a BCR of 8.2 (Kuklinski et al., 2015). The most comprehensive investment analysis has been conducted by Stelmach et al. (2022), which estimated a BCR of 23.6 for a range of intervention programmes across 36 countries.

These are illustrative of successful intervention programmes that both reduce mental disorders for adolescents and deliver very substantial ROIs.

5. *School feeding – one key response to malnutrition*

5.1 Introduction

This chapter concentrates on interventions related to school feeding. These are critical to an overall response but by no means are the only approach to addressing malnutrition. While recognizing the complex nature of this global problem and pointing to the extensive literature on its various dimensions, we have not been able to adequately survey and analyse the literature on all of those dimensions, but highlight the important role that school feeding plays.

Malnutrition, which covers undernutrition, micronutrient deficiencies and obesity, remains a critical challenge for current and emerging adolescent cohorts. Indeed, the DBM, which is the simultaneous manifestation of undernutrition and overweight/obesity, affects most LICs and MICs (Popkin et al., 2020). Many young people in most countries also suffer from micronutrient deficiencies. DBM increased most in LICs and MICs between 1990 and 2010 with Indonesia experiencing the biggest increase. Many other Asian and sub-Saharan countries have also seen big increases in DBM.

Sustained action to address these issues has been widely discussed in the literature, reviewed briefly below, and some modelling has been done. The impact of malnutrition comes through three channels:

- inadequate intake of micronutrients, such as various vitamins, iron, iodine, zinc and folic acid, which can predispose adolescents to various adverse effects, such as susceptibility to infections, anaemia, cognitive defects, maternal haemorrhage, birth defects and diseases;

- hunger and macronutrient or protein-energy undernutrition, giving rise to stunting, underweight and thinness; and

- overweight and obesity, giving rise inter alia to poor cardiovascular health and an increased risk of cardiovascular disease in later life.

The key interventions to address malnutrition are micronutrient supplements of various types and a further expansion of school feeding programmes. These should be integrated with programmes to provide supplements or fortified foods, supported by steps to improve the quality of the food available to young people and their communities. There is increasing empirical evidence on school feeding programmes, suggesting that they provide high returns. Important elements in the malnutrition crisis are the shift to commercialized, global systems of food production and distribution, which often generate less healthy foods—those that are energy-dense but nutrient-poor—at the lowest price. This makes it difficult to access healthy food, especially for families that are time- or income-poor.

5.2 Recent studies and action, both locally and globally

5.2.1 An emerging literature on malnutrition in adolescents

Table 5.1 provides a list of key papers focused on the complex issues surrounding malnutrition in adolescents. This selection from the literature includes:

- five papers in Volume 8 of the 3rd edition of *Disease Control Priorities* (DCP3) published in 2017 (Jamison et al., 2018; and at https://www.dcp-3.org/about-project);

- survey papers in two series in *The Lancet*, one series on the DBM in 2020 (Popkin et al., 2020; Wells et al., 2020); and one series on adolescent nutrition in 2022 (Patton et al., 2022; Norris et al., 2022; Neufeld et al., 2022; Hargreaves et al., 2022);

- two important papers in *Frontiers in Public Health* in 2020 (Verguet et al., 2020; Drake et al., 2020); and

- three UN agency or multi-agency reports (FAO et al., 2022; World Food Programme, 2023; UNESCO, UNICEF and WEF, 2023).

Table 5.1 **Selected papers in the emerging literature on malnutrition in adolescents**

Publication/reference	Title
Disease Control Priorities (3rd Edition)	
Lassi et al. (2017)	Nutrition in middle childhood and adolescence
Drake et al. (2017)	School feeding programmes in middle childhood and adolescence
Bundy et al. (2017)	Deworming programmes in middle childhood and adolescence
Nandi et al. (2017)	The human capital and productivity benefits of early childhood nutritional interventions
Ahuja et al. (2017)	Economics of mass deworming projects
Lancet Series: Double Burden of Malnutrition	
Popkin et al. (2020)	Dynamics of the double burden of malnutrition
Wells et al. (2020)	The double burden of malnutrition: aetiological pathways and consequences for health
Frontiers in Public Health	
Verguet et al. (2020)	The broader economic value of school feeding programmes in low- and middle-income countries
Drake et al. (2020)	Establishing global school feeding programme targets
Lancet Series: Adolescent Nutrition	
Patton et al. (2022)	Nourishing our future
Norris et al. (2022)	Nutrition in adolescent growth and development
Neufeld et al. (2022)	Food choice in transition: adolescent autonomy, agency and the food environment
Hargreaves et al. (2022)	Strategies and interventions for healthy adolescent growth, nutrition and development
Multi-agency reports	
FAO et al. (2022)	The state of food security and nutrition in the world 2022
World Food Programme (2023)	The state of school feeding worldwide 2022
UNESCO, UNICEF and WFP (2023)	Ready to thrive and to learn – school health and nutrition around the world

It is beyond the scope of this report to explore the arguments and conclusions of this literature in any detail. However, the following points are highlighted here:

- **Neglected area of research.** A common theme across this literature is the need for expanded research in a wide range of areas from scientific studies of nutrition and development in humans and the effect of nutrition on interrelated aspects of growth to the policy dimension of food choice in an age group keen to shape their own choices. Many dimensions of the malnutrition challenge need to be understood more fully.

- **Nutrition and adolescent development.** This limited knowledge is especially surprising given that adolescence is a time of remarkable growth; adolescent height velocity is second only to the first two years of life. In such a rapid stage of transition, the level and quality of nutrition will play a central role.

- **The school as a pivotal location for action in the role of school feeding.** A common emphasis in the literature and in the application to policy is that the school can play a major role in improving adolescent nutrition. This has led to the global emphasis on school feeding programmes.

- **More limited uptake of school feeding in LICs.** While there is a growing uptake of school feeding programmes in many countries, this is still constrained by funding and other factors in LICs where it is arguably most needed.

- **The global change in the food system and the inadequate supply of good quality food.** As noted above, the shift to commercialized global systems of food production and distribution has added to the malnutrition crisis, making access to healthy food more problematic.

- **Evidence of good returns to broad-based school feeding programmes.** The few studies that are available (Verguet et al., 2020) have found strong evidence of economic and social benefits from such programmes that suggest good returns, but more extensive work is necessary.

- **Large-scale international action is underway.** Widespread action is underway globally led by groups such as the School Meals Coalition (discussed in the next section).

- **The broader policy picture for malnutrition.** In one of the papers in *The Lancet 2021 series on adolescent nutrition*, Hargreaves et al. (2022, p198) summarize the required policy strategy as follows:

  > … effective interventions and policies will need to cut across sectors; be supported by multifaceted and multilevel policy; and extend across education, health, food systems, social protection and digital media. Better data standardization and systems will be essential in coordinating and monitoring these responses. In a context of shifts in planetary ecosystems and commercial drivers, resilient food systems will need to both ensure access to healthy and affordable foods and provide the infrastructure and incentives for continuing physical activity. Intergenerational partnerships with young people will be essential in bringing about transformative change and ensuring that food policies reflect their needs and aspirations.

5.2.2 Emerging action – the case of the School Meals Coalition

The School Meals Coalition is an unprecedented coalition of more than 90 governments from around the world, working with academia, international agencies and financial groups (such as the World Bank and international development banks) and many other partners to increase the coverage and quality of school meals around the world.

The COVID-19 crisis adversely affected global school feeding programmes, but the latest report from the World Food Programme (2023) indicated that by 2022 the level of school feeding had rebounded beyond the pre-pandemic peak in most countries other than in LICs. In 2022, 418 million children benefited from school feeding programmes compared to the pre-pandemic peak of 388 million. This meant that approximately 41% of children involved in primary schools had access to free or subsidized school meals, rising to 61% in HICs. However, in LICs, there was a fall of 4% over this period. In terms of funding, while LICs increased their domestic funding for school meals significantly between 2020 and 2022, there was a 20% reduction in international support.

Beyond 2023, the main goals of the Coalition are to reach, by 2030, those who have been missed (the most vulnerable in LICs and LMICs) and to improve the quality and efficiency of school meal programmes in all countries.

5.3 The key messages of Ready to Learn and Thrive

The key messages of the important 2023 multi-agency *Ready to Learn and Thrive* review led by UNESCO, summarized in Table 5.2, highlight the importance of both school health and nutrition programmes as part of a broad enhanced schools programme. The emphasis in this current report on the critical role of enhanced school programmes in addressing the well-being of adolescents aligns well with these review messages.

Table 5.2 **School health and nutrition programmes, summary of the key messages of the multi-agency report Ready to Learn and Thrive (UNESCO, UNICEF, WFP, 2023)**

1. The health, nutrition and well-being of learners are key determinants of education outcomes.

2. Almost every country in the world implements school health and nutrition programmes.

3. Such programmes are cost-effective and feasible in all settings, and deliver significant gains.

4. School health and nutrition programmes promote inclusion and equity in education and health.

5. More attention must be paid to the school environment, critical to health and learning.

6. More comprehensive and sustained school health/nutrition programmes are required.

5.4 Some modelling results

The important work of Verguet et al. (2020) is one of the few available quantitative studies of school feeding programmes to carry through to the estimation of a BCR. These researchers developed a methodology to estimate the costs and benefits of school feeding programmes in 14 countries in Latin America, South Asia and sub-Saharan Africa, choosing countries where school feeding programmes had been studied in depth and for which data sources and key input parameters were readily available.

Verguet et al. (2020) examined the costs and benefits of school feeding programmes, including, in many cases, deworming medication and other services in these countries. The coverage of the programmes in the countries varied, from being mandated in all public schools in Brazil and India to being focused on disadvantaged groups in some other countries. The researchers noted that such programmes can incorporate bio-fortified foods and provide benefits to local families as well as social protection benefits (equal to the value of the food provided) to the families of recipient children.

Verguet et al. (2020) modelled four types of benefits:

- health benefits from the avoidance of anaemia and STHs in terms of the estimated value of the DALYs avoided;
- education benefits, in terms of the higher lifetime wages arising from each additional year of school;
- the value of the social protection benefits; and
- the estimated value of the impact on the local agricultural economy.

The costs of delivering the programmes were derived from the local authorities administering them in the 14 countries. Of the four benefits, the most important in quantitative terms were the education benefits. Drawing on existing literature, the researchers assumed that school feeding programmes generate, on average, a 9% increase in school attendance and that an additional year of schooling leads to a 9% increase in future wages.

The results of the study imply that the BCR for the school feeding programmes studied, including only the health and education benefits, is 17.0. The main uncertainty identified is the estimated level of future wages for individual countries. If a range of alternative assumptions about future wages is used, the BCRs range from 7 to 35. In addition, the social protection and agricultural economy benefits will be significant but were not modelled.

While further studies are needed, this is an important study with powerful findings.

5.5 Conclusion

As noted above, adolescent malnutrition has not been fully explored in this report. This is partly because research on the many dimensions of adolescent nutrition is limited and major gaps exist. It remains an important area for future research.

Despite these limitations, several things are clear. Highly significant school feeding programmes have been and are being implemented with the strong involvement of governments and many international agencies in the countries concerned. However, for various reasons, the application of school feeding programmes in LMICs is still limited.

There is an evident need to address the global trend in which the food industry is becoming dominated by multinational companies, producing nutrient-poor, energy-dense foods at the expense of local farmers and producers.

Finally, it is indisputable that improvements in the various dimensions of adolescent nutrition are vital to improving adolescents' future well-being, and that measures to this end must be a key component of an adolescent investment programme.

6. *Education, skills and employment*

This chapter analyses the impact and unit cost of nine interventions designed to improve quality education and reduce dropout. These were identified using analyses of the literature.

In the early 21st century, good quality education, at least to secondary level, is vital for adolescents to build the capabilities required to live productive, empowered, connected and satisfying lives. However, in many LICs, sometimes 30% or less of young people complete secondary school and, when they do, the quality of their education is often of poor quality. There is substantial evidence that better education has many benefits from better health and increased empowerment to an increased likelihood of securing and being productive in a higher-quality job. In this chapter, we concentrate on the latter—the impact of better education on the level and quality of employment obtained—and, hence, on the earnings and productivity of individuals and of the society as a whole. We extend the analysis to various forms of post-school training but do not cover higher education.

Formal schooling is essential for successful inclusion in present-day societies and for the well-being of young people. While there are various types of education, usually traditional, formal schooling dictates the way one's educational success is measured. People who attend school and attain a higher level of education are more employable and are likely to earn more. Education helps eradicate poverty and hunger, giving people the chance of better lives.

Without education, it is harder for people to participate in society or to live the kind of life they want. We all have the right to a quality education in order to help us reach our full potential, learn the skills necessary for the job we want, help us decipher how to make things and find solutions to different problems.

In this chapter, we briefly review the key facts about attendance at school, school completion and the quality of learning achieved. We then summarize the two models we used to analyse schooling and its implications (an education and a benefits model) before reporting the results achieved.

6.1 School attendance and the quality of learning

6.1.1 Attendance at school

Since 1970, overall schooling attendance rates in most LICs and MICs have experienced unprecedented increases. Involvement in both primary and secondary education has dramatically increased. Greater gains have been made in primary school, although some children still do not have access to this level of schooling.

The main barriers to accessing increased education have been poverty, gender, ethnicity, disability and living in a conflict-affected area. Conflict-affected regions, in particular, are a significant exception to the rapid increase in schooling rates. It is these regions that have more than one third of out-of-school children of school-going age. This is consistent with the reduced likelihood of completing school, which is 30% less likely for primary school and 50% less likely for secondary school. Dropout rates in conflict-affected areas are higher, together with lower literacy rates and the lower attendance of girls in school. Despite this, in most continents since 1970, attendance rates in both primary and secondary schools have risen strongly.

Rates of school attendance have risen strongly for both girls and boys, although, reflecting historical trends, average years of formal education received by women are much lower than for men in sub-Saharan Africa, the Middle East and North Africa and Asia.

6.1.2 Completion of primary and secondary school

Despite progress, improvements in educational outcomes continue to be difficult to achieve in many countries. The lack of progress is most evident in south and west Asia as well as sub-Saharan Africa where many girls still do not complete primary school. As of 2014, the primary school enrolment rate of girls in LICs was 78%, but the completion rate was only 63%. In HICs, and Europe and Central Asia, less than 15% of the population

does not complete secondary school. However, for LICs and MICs, this figure is approximately 50%. In addition to substantial gains in primary school education, secondary enrolment rates have increased over the past 50 years to more than 50% in every region except sections of sub-Saharan Africa. Despite this increase, there are still significant gaps between LICs and HICs. In 2016, over 90% of all children completed secondary school in HICs within the Organization for Economic Cooperation and Development (OECD). However, in many countries in South Asia, and East and Northern, as well as sub-Saharan African LICs, this figure was less than 40% (Figure 6.1).

Fig. 6.1 **Educational attainment by country group as defined by Filmer et al. (2018, p59) using data from Lee and Lee (2016)**
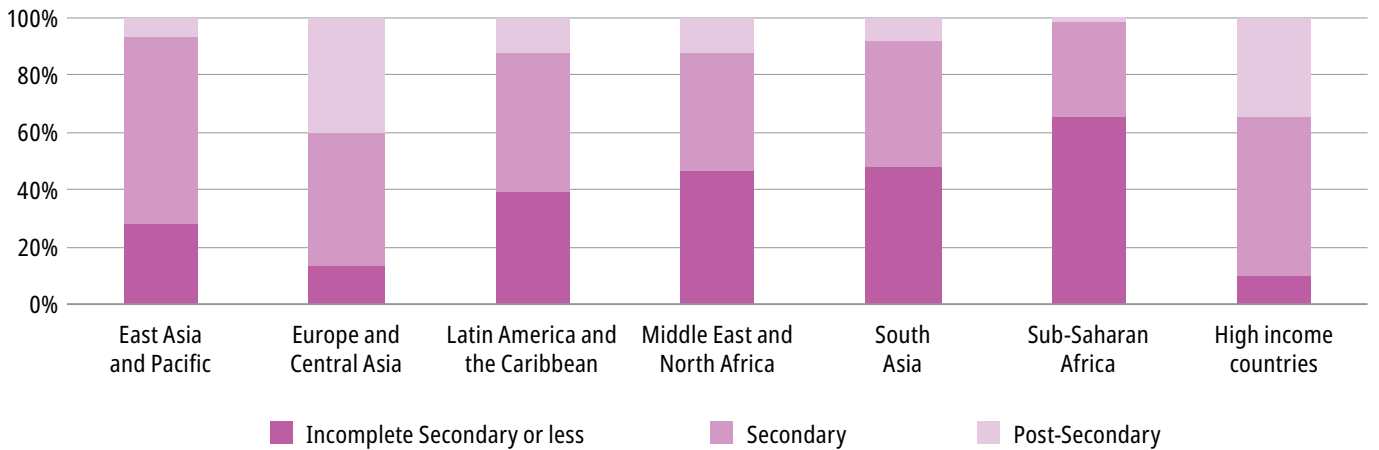
6.1.3 Achieving learning outcomes

The gaps in school completions between HICs and LICs are large and some LICs are still catching up in terms of school attendance, but there is a much greater challenge in terms of learning achievement. In too many instances, students are unable to read and understand a simple text by age 10, which is an indicator of learning poverty or deficit. At the primary level, this is mainly due to poor quality learning. In contrast, at the secondary level, both high dropout rates as well as poor learning quality are major contributors to the learning deficits. Angrist et al. (2021) highlighted the persistent difference in primary school learning across different regions, as measured by comparable international test scores. It is notable that, in spite of rising enrolments, there has been little change in average test scores over the period 2000–2015 in the regions with the lowest scores, particularly sub-Saharan Africa, the Middle East and North Africa (Fig. 6.2). Unfortunately, the data for South Asia is not available.

Fig. 6.2 **Primary school learning test scores by region, not including South Asia**
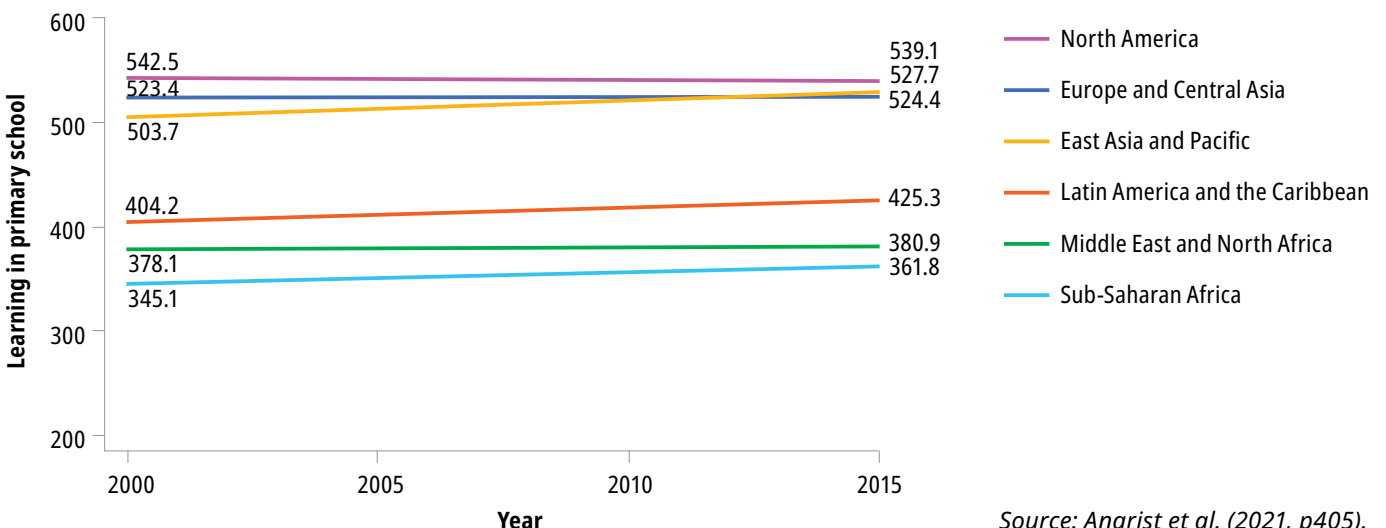
Source: Angrist et al. (2021, p405).

This finding of stagnation in learning, often at low levels, is consistent with other indicators. The World Bank describes the widespread learning poverty in some regions as "a global learning crisis."

The specific learning poverty indicator introduced by UNICEF (2022a) and the World Bank is one of being unable to read and understand a simple text by age 10, as noted above. This indicator brings together schooling and learning indicators. It begins with the share of children who have not achieved minimum reading proficiency (as measured in schools) and is adjusted by the proportion of children who are out of school (and are assumed not able to read proficiently). Reading is a gateway for learning as the child progresses through school and, conversely, an inability to read closes the gate. When children cannot read, it is usually an indication that school systems are not well organized or effective in helping children learn in other areas such as maths, science and the humanities. While it is possible to learn later in life, children who do not read by age 10 or by the end of primary school often fail to master reading later in their schooling career unless assisted by relevant interventions. Fig. 6.3 shows the regional levels of learning poverty, with estimated post-COVID values for 2022.

Fig. 6.3 Learning poverty, globally and by region
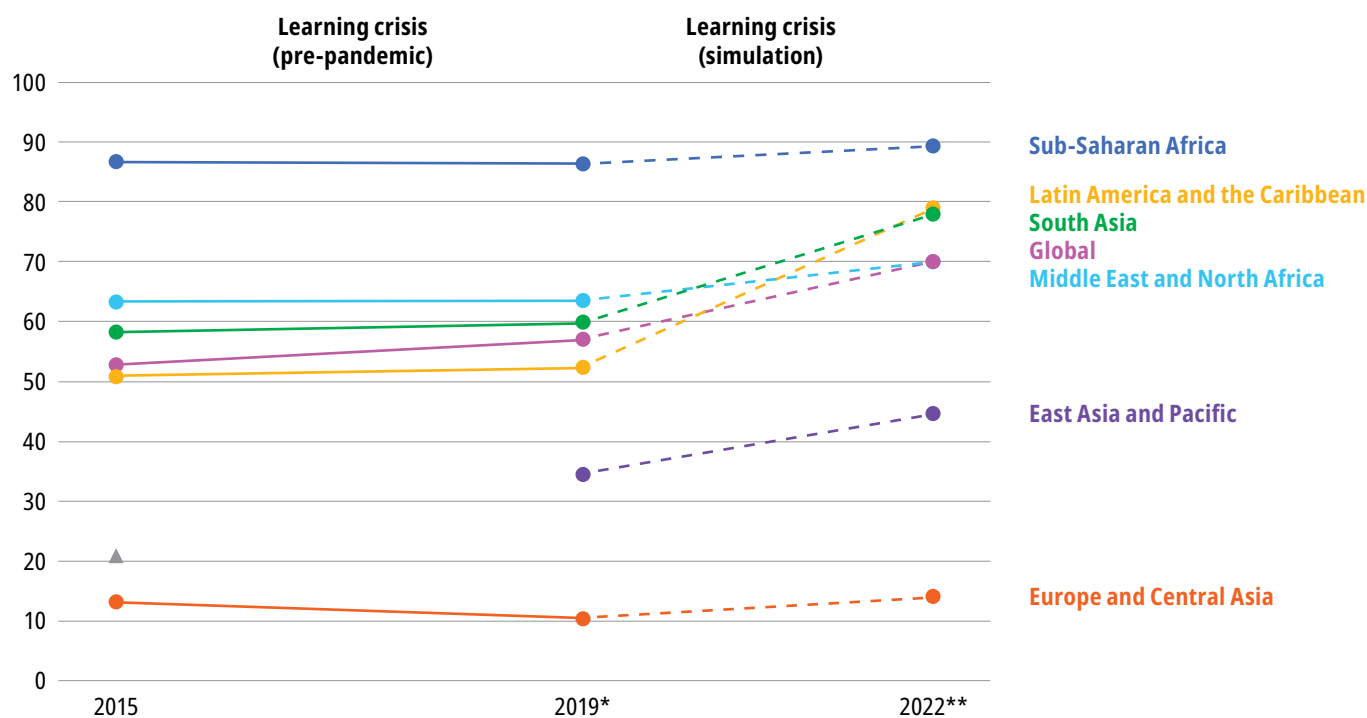
*Notes: *For the East Asia and Pacific region, the 2015 and 2019 averages are not directly comparable due to major improvements in data quality and availability and new assessments recently available for the two years. **Numbers for 2022 are simulations. The global figure is for all LICs and MICs. Regional and global figures are all population-weighted averages. Data for North America was not available. Source: UNICEF (2022, p9).*

The study reported in this chapter focused on a particular aspect of the challenge of inadequate education: improving the secondary school outcomes of adolescents by reducing the probability of early dropout and by improving the quality of learning, thereby reducing learning poverty, in 60 LICs and MICs.

6.2 Methodology – education model

6.2.1 Model methodology

The education model used here to analyse the impact of educational interventions is the VEM, constructed for the analysis of a wide range of LICs and MICs. The model was first outlined in Sheehan et al. (2017), documented in detail in Wils et al. (2019) and further developed in case studies for Syrian Arab Republic, India and Burundi (Rasmussen et al., 2022; Selvaraj et al., 2020; Rasmussen, Sheehan et al., 2019).

This model starts with a standard cohort model of educational attainment and projects to a school completion matrix of pupils by grade and gender over time. It is dependent on the initial intake, flows to the next grade based on promotion or transition rates and to the same grade in the next year based on repetition rates. It utilizes data from the UNESCO Institute of Statistics (UIS) (2023) and the World Bank (2023b) as well as from the Demographic and Health Surveys (DHS Program, 2023) and Multiple Indicator Cluster Surveys (MICS) (UNICEF, 2023c) to introduce an age grade component into the model. This component enables the model to track the progression of students by age, grade and gender.

Changes to education outcomes are driven from the bottom up by assumptions about intervention coverage and effectiveness that are assumed to increase linearly from 2024 to 2035 when the coverage (for example, the proportion completing secondary school) is assumed to be 100% of the student population, and this level is maintained until 2050. The cost of the interventions consists of the direct cost of the interventions, such as a school feeding programme themselves and the cost of educating the additional number of students attending through to the final year of secondary school, as reduced dropout increases the number of students in school. For some interventions, the costs fall after 2035 as the resources needed to maintain a given effect decline once full coverage has been achieved.

The sizes and costs for interventions used are listed in Table 6.1. It is assumed for this application that these figures can be generalized and applied for country-specific assessments. This assumption is made on the basis that children and adolescents have the same cognitive makeup everywhere, but it is clear that this assumption has limitations as cultural and regional differences may render some of these effects different from country to country. Further country-by-country analyses would be valuable.

6.2.2 Investments and impact

There have been many systematic reviews and meta-analyses to evaluate the best education interventions improving the quality of learning and reducing dropout. Some of these include Angrist et al. (2020), Masino et al. (2016), Damon et al. (2019), Springer and Miller-Grandvaux (2022), Asim et al. (2015), Ganimian and Murnane (2016), Sampa et al. (2021), Evans and Popova (2016), Evans et al. (2023) and Conn (2014). We have undertaken a detailed review of these and other sources.

The interventions utilized in the modelling are all represented in the systematic reviews. The interventions included in the modelling are shown in Table 6.1 alongside their effectiveness and costs. The values used in modelling are average values from those identified in the systematic and meta-reviews. We excluded some interventions identified in the literature as the evidence for them was not as strong as for other interventions, such as public-private partnerships, school vouchers, additional education supplies, parent-teacher partnerships, pupil-teacher ratios, school-based management programmes, teacher performance pay, tutoring programmes and multi-level learning materials.

6.2.3 Intervention selection

Following the practice of Conn (2014) and Damon et al. (2019), interventions were reviewed in terms of their ability to increase time in school and to increase student learning; some interventions affect both. The effectiveness of interventions has historically been reported as absolute value change, as standard deviations, as percentage changes or as coefficients in a regression. Another approach to measure the effectiveness of interventions is via the learning-adjusted years of schooling (LAYS).

LAYS for a given country, referred to as macro-LAYS by Angrist et al. (2020), are the product of years of schooling and a measure of schooling quality. They are produced by scaling the country's average schooling by its test score performance relative to global benchmarks such as Trends in International Mathematics and Science Study (TIMSS), Programme for International Student Assessment (PISA) or Early Grade Reading Assessment (EGRA). However, macro-LAYs cannot be used to assess the effectiveness of individual interventions. Consequently, a metric to assess individual interventions, micro-LAYs, was developed. In order to make cost-effectiveness comparisons, Angrist et al. (2020) converted the impact of increased LAYS for every US$100 invested.

A number of assumptions are required to translate existing studies' measures into micro-LAYS. To ensure a coherent, unifying approach, the micro-LAYS methodology invokes assumptions similar to those used in constructing macro-LAYs. Given the additional complexity involved in constructing micro-LAYS for each

intervention, this study utilized impacts in terms of standard deviations or percentage changes for interventions related to either time in school or student learning.

It is important to note the biases and the limitations of the research reviewed. First, the research overall, and certainly our selection of what has been published, is limited in scope and inevitably misses a number of effective interventions. Second, the effectiveness of interventions varies considerably by context and by mode of implementation. It is not possible to cover all contexts. As in practice, the research included only a few different situations.

Another form of bias is that positive results are more likely to be published than negative or insignificant ones. It is likely that, in the coming years, improvements in knowledge may reduce these limitations. The results are presented here in full awareness of these limitations, but with some confidence that these findings are a reasonable representation and synthesis of what is known about these interventions at this time.

Time in school interventions

The amount of time a child spends in school depends upon several factors. Damon et al. (2019) categorized these factors as: demand for education, school inputs, pedagogy and governance. In the past two decades, investigation of the benefits of SEL has attracted increasing interest as it is one factor that can influence the time a young person spends in school.

The interventions about increasing time in school with the most high-quality evidence include:

- CCT;
- building new schools in underserved areas;
- improved pedagogy;
- school meals/nutrition;
- merit-based scholarships;
- female-friendly schools with a special focus on water, sanitation and hygiene (WASH) in Schools (WinS) (UNICEF, 2014);
- deworming and malaria prevention (where required);
- ICT assistance;
- teaching at the right level/remedial teaching; and
- teacher incentives when combined with CCT as well as SEL.

Student learning

The same categories that apply to time in school also apply to student learning. The interventions with the greatest evidence to increase student learning through demand for education, school inputs, pedagogy and governance overlap considerably with those that increase time in school. These interventions include building new schools in underserved areas, the provision of school meals/nutrition, merit-based scholarships, deworming and/or malaria prevention activities, improved pedagogy, remedial teaching, ICT, combined CCT, teacher incentives and SEL.

While extensive evidence exists for the effectiveness of CCT, recent studies have suggested that they are more effective when implemented in combination with SEL. Consequently, CCT was only modelled in combination. These interventions and their impact are summarized in Table 6.1. The metric for the effectiveness of education interventions is either a standard deviation change or an improvement of a certain percentage, depending on how the relevant studies were measured. While standard deviations are not as simple to understand as an improvement in percentage points, generally, the larger the standard deviation, the bigger the expected change. Additionally, the larger the initial gap, the bigger the expected change. In other words, the same intervention with the same standard deviation effect will generate a bigger percentage point shift in an outcome in a population that has a greater initial disadvantage in that outcome.

If the data are normally distributed, a one standard deviation improvement will move the median student up to the 16th percentile from being the 50th best student in a class of 100. For a binary outcome like dropout, a one standard deviation improvement will shift an initial 50% probability of dropping out of school to a 16% chance. Typically, the effect of an intervention is only a small fraction of a standard deviation. For example, if an intervention has a standard deviation improvement in dropout rates of 0.38, this means that the mean of the distribution is shifted 0.38 standard deviations.

The effectiveness of each intervention refers to the reduction in learning gaps as well as dropout rates. One intervention may affect both dropout and learning gaps. The impact of each intervention is the combined effect of the percentage of the population that is covered and its effect on those people who receive the intervention.

Table 6.1 includes the costs of each intervention as a percentage of base unit costs. Base unit costs are the estimated costs of education per student in each country prior to the interventions, modelled from World Bank and UIS data, which includes the number of teachers, salaries, materials and ongoing support and school construction. The cost of interventions as the percentage of base unit costs provides a standardized measure of each intervention.

Table 6.1 **List of modelled education interventions, 64 countries**

Intervention	Dropout		Learning		Cost (% of education base unit costs)
	%	SD	%	SD	
Building new schools in underserved areas	17.2%		58.3%		13.9%
School meals/nutrition	9.5%		3.2%		35.8%
Merit-based scholarships	10.7%			0.223	12.5%
Female-friendly schools (WASH)		0.112			5%
Deworming and/or malaria	5%			0.200	1%
Remedial teaching/teach at the right level	38.3%			0.178	5.9%
ICT		0.100		0.420	11.8%
Improved pedagogy	25%			0.250	10%
Combined CCT and teacher incentives	10.3%			0.263	10%
SEL	5%			0.260	7.2%

Notes: % refers to the percentage change in the target variable as a result of the interventions; SD means the number of standard deviations by which the intervention shifts the target variable.

6.3 Results – education outcomes

The interventions are forecast to increase female school completions by approximately 215 million and male school completions by 240 million by 2050, excluding China (see Table 6.2). This represents an increase in school completions of 43.3% for females and 45.7% for males. The interventions also lead to an increase in average years of schooling, even where some students do not complete secondary school. The average years of schooling increase by 12.8% for females and 14.4% for males. While China is included in the overall analysis and in the subsequent tables, it is excluded from Table 6.2 because it already has high rates of secondary school completions.

Table 6.2 Educational outcomes, 64 countries (excluding China)

Aggregated countries	Base case school completions	Intervention case school completion	Increased school completions	Increased school completion %	Increased average years of schooling %	Costs US$ million
Male	525 551 078	765 869 760	240 318 682	45.7%	14.4%	
Female	495 472 389	709 771 223	214 298 834	43.3%	12.8%	
Total	**1 021 023 466**	**1 475 640 983**	**454 617 516**	**44.5%**	**13.6%**	**$3 234 877**

The results of the education model are used in the employment model in order to calculate the economic benefits associated with improved education outcomes.

The model analysis of the nine interventions selected for this study shows that increasing these interventions through to 2035 would increase secondary school completion by approximately 45% for all countries studied, excluding China. The transformative effects of more and better education in the process of economic and social development through the implementation of the interventions are discussed in Chapters 1, 4 and 5.

6.4 The benefits model – methodology

The benefits model uses the results derived from the education model described above for the impact of the education and training initiatives on key component outcomes or channels of macroeconomic effects, individual productivity and mental health and well-being. The benefits model calculates changes relative to a base case resulting from the application of the set of educational interventions across countries. The starting point for the benefits model is the base case GDP path and the investment over time in education and training initiatives. The three channels through which these investments and the improved education and training outcomes give rise will provide benefits to affected populations.

First, substantial new investment in education and training will have macroeconomic effects. These are the multiplier effects of the increased investment expenditure and enhanced ability to innovate locally and by making use of technologies and practices in best-practice countries. The impact of these factors on GDP will be reduced by the high leakage of expenditure into net imports, which is likely to continue for some time.

The second component is the impact of better education and training on the individual productivity of the cohorts who receive that education and training. There are several aspects of this impact:

- an increase in productivity for each completed year of schooling;
- increased productivity when at work resulting from better quality learning while in school;
- increased productivity and employment arising from upgrading an educated workforce from informal to formal work; and
- the productivity effects of improved job skills, such as those arising from vocational training and the development of IT/Internet skills and interpersonal skills.

The third component is the effect of better education and training on the health, including mental health, and well-being of the cohorts and their children. These include:

- the benefits (in addition to improved school performance) of these programmes on the mental health of adolescents;
- lower child marriage and cohort fertility arising from better education and the demographic dividends arising from these changes; and
- reduced infant mortality arising from better maternal education.

6.4.1 The investment multiplier

Since the writings of John Maynard Keynes (1936), the investment multiplier has been a staple of macroeconomic analysis. The basic idea is that expenditure by a government, for example, will be in the hands of those who do the work or sell the goods. The recipients of the income will spend part of the income and save the rest, leading to new spending, saving and so on. The result of this process is that the increase in GDP is likely to be greater than the initial investment. If there are no other factors involved, the multiplier is equal to 1/ (1- Marginal Propensity to Consume) . If the marginal propensity to consume was 60%, the multiplier would be 2.5.

But there are always other factors involved. For example, some income will be spent on imports or other leakages. If the economy is fully employed, either the initial investment or subsequent spending rounds will substitute for, rather than be additional to, existing activity. Therefore, evidence from actual economies needs to be considered.

Economists at the Global Infrastructure Hub (the G20's infrastructure entity) (GI Hub, 2020) have recently reported the results of their analysis of more than 3000 estimates of the fiscal multiplier from more than 200 academic studies over the last 25 years. This meta-analysis, conducted to support the *G20's Action Plan in Response to the COVID-19 Pandemic*, found that public investment has an average fiscal multiplier of approximately 0.8 within one year and around 1.5 within two to five years. These multipliers are higher than those found for public spending as a whole across both timeframes. They found that this multiplier effect tends to be larger, at around 1.6, during the contractionary phase of the economic cycle, suggesting that public investment is generally less likely to crowd out private economic activity in times of recession.

For this study, we used an investment multiplier of 1.2 with equal effects over three years and an import leakage of 20%, falling over time to 10%.

6.4.2 Education, innovation and human capital

As noted earlier, the evidence is clear that better education has many benefits - from better health and increased empowerment to an increased likelihood of securing, and being productive in, a high-quality job. In this analysis, we concentrate on two aspects of these benefits: the general impact of better educational outcomes and improved human capital on innovation throughout the economy and the impact of better education on the level and quality of employment obtained by individuals, and hence on their earnings and productivity.

An extensive amount of research links educational outcomes, both years of schooling and quality outcomes, to GDP growth at an aggregate level. Much of this literature has involved studying the impact of education and human capital more generally on economic growth, partly in the context of seeking to explain the existence of distinct differences between countries in GDP per capita levels and, hence, in living standards.

Two main methods have been developed. One stream emerged from the demonstration by Mankiw et al. (1992) that introducing a human capital variable based on educational attainment into the production function much improved the predictive power of the Solow/Swan growth model (Solow, 1956). Although some single factor analyses have continued, this literature quickly expanded into an analysis of the role of human capital as one of the many factors that shape cross-country differences in GDP per capita and growth rates. Much of this analysis has made use of successive generations of the Barro and Lee cross-country database (2013) and has focused on years of schooling as a measure of educational attainment and, hence, of human capital. Recently, there has been increasing emphasis on the growth effects of improving the quality of educational outcomes.

The other standard approach has been to start from the Mincer equation (1974) in which log earnings are a function of schooling and experience augmented by other variables that might affect this relationship. The result of estimating this equation, which is the percentage increase in earnings (or productivity) for an additional year of schooling, is often referred to as the return to education. Montenegro and Patrinos (2012, 2014) have estimated a return to education for many countries using private sector earnings data.

A variant of these approaches, developed by Barro and Sala-i-Martin (2004) and employed extensively by Hanushek (2013), is to undertake cross-sectional regressions across many countries to estimate the returns to education in terms of enhanced GDP. These analyses typically use five-year averages of human capital (education) and GDP growth over the long-term to estimate the impact of education on growth. Given this methodology, this analysis does not produce a result for any specific country.

Although this macroeconomic literature is vast and there are many voices dissenting on various aspects, the central conclusion is that there are very high returns, in terms of higher GDP or higher GDP growth, to improvements in both educational outcomes measured in years of schooling and to educational quality measured by test scores. It is also widely agreed that the impact of education is in addition to that of other factors that contribute to higher growth, such as economic and social institutions and convergence in technologies, and that the role of education can be seen as, at least in part, a causal one in generating growth as a response to improved educational outcomes.

Although these conclusions can be, and have been, criticized in terms of both data and methodology, they undoubtedly point to a strong, long-term link between education and growth. They provide a solid context within which our more disaggregated model was developed.

6.4.3 The productivity effects of improved human capital

In our earlier work (e.g., Sheehan and Shi, 2019), we have stressed the need to be more specific about the mechanisms underlying these aggregate effects and to take account of individual country variation. In doing so, the benefits model is focused on two different types of human capital effect, emerging from the discussion above. The first is a generalized effect of higher human capital on growth, considered further in this section, and secondly, the impact of better educational outcomes on individual and cohort productivity.

At the economy-wide level, higher human capital would facilitate greater innovation and technology adoption throughout the economy. Higher human capital increases a country's ability to innovate, both in terms of making use of technologies new to the country and adapting such technologies to meet local needs. While this effect is well understood, the precise magnitude of the effect in different countries and circumstances is hard to pinpoint. Given this uncertainty and the complexity of the situation in individual countries, we assume for the current model an elasticity of GDP with respect to secondary school completions of 0.1 with a suitable lag (see Table 6.3). This means that every 10% rise in secondary completions leads, in due course, to a 1% growth in GDP. This is a conservative assumption and is well below the elasticities implied by the studies noted above.

In the employment model, increased years of schooling and of better quality improve lifetime productivity for the relevant cohort of school leavers, and completing secondary school improves an individual's chance of obtaining a formal job as opposed to working in the informal sector. Post-school training initiatives in trade skills, vocational training and non-formal training in innovation and entrepreneurship increase the individual's productivity when at work. The increased productivity of each cohort is traced through their working lives, tracking each cohort of school leavers from age 20 to 24 years, with the effect building up as successive cohorts of school leavers with enhanced productivity enter the workforce.

We measured the impact of these interventions relative to an unchanged policy base case, which is relative to the GDP path that would be generated by these cohorts without the enhanced educational and training outcomes.

Four key relationships drive the increased productivity of young people as a result of these initiatives:

- the increased productivity over the individual's working life arising from an additional year of schooling;
- higher productivity over the working life resulting from higher-quality learning in better schools;
- better access to formal employment as a result of completing secondary schooling; and
- higher productivity arising from trade, vocational or innovation training.

Table 6.3 provides a summary of the key parameter settings used in the benefits model for this report. For a further discussion of these values, see Sheehan and Shi (2019).

Table 6.3 *Parameter settings used in the education benefits model, 64 countries, 2024–2050*

Parameter	Preferred case
Macroeconomic	
Base case GDP growth rate	4%
Investment multiplier	1.2 (over 3 years)
Innovation effect – elasticity of GDP with respect to completions	0.1 (lagged 5 years)
Import leakage	20% falling to 10%
Education and training	
Return to a year of schooling	Country specific
Elasticity of productivity with school quality	0.125 (lagged 8 years)
Elasticity of employment type with respect to completions	+0.307, -0.071, -0.236 (Female) 0.197, -0.171, -0.026 (Male)
Productivity increase (relative to average base case Years 9–12) > Upshift > Training in trades (e.g., carpentry, electrical, etc.)	10% 20%
Participation rates > Early school leavers > Persons aged 20–24	0.2 0.6

6.5 Results

6.5.1 Impact of interventions on educational outcomes

Table 6.4 summarizes the main outcomes from the education and benefits models arising from the interventions extended out to 2050. We have separated them into three income groups, to show how the results vary across these income groups.

Table 6.4 *Impact of the interventions on selected educational and economic outcomes across 64 countries, by 2050*

	Low-income	Lower middle-income	Upper middle-income	Total
Education				
Increase in average grade attained (grades)				
Girls	1.5	1.1	0.8	1.1
Boys	1.6	1.2	0.8	1.3
Share of 20–24-year-olds who have completed secondary school (% increase)				
Girls	23.4	22.7	22.4	23.6
Boys	24.6	25.2	18.4	24.9
Change in activity of 20–24-year-olds in 2035 (million persons)				
Formal employment				
Girls	413	524	109	1046
Boys	181	82	50	313

*Table 6.4 **(continued)***

	Low-income	Lower middle-income	Upper middle-income	Total
Productivity per employee of 20–24-year-olds (change by 2035, %)				
Girls				
Individual earnings effect	21.6	9.6	8.2	13.1
School quality effect	38.8	16.6	9.8	24.3
Employment level effect	1.6	3.0	1.7	2.1
Employment type effect	0.78	1.7	1.1	1.3
Skills training effect	4.7	6.0	6.6	5.7
Total	**66.4**	**37.0**	**27.4**	**47.2**
Boys				
Individual earnings effect	17.6	9.9	7.1	11.8
School quality effect	37.8	16.6	7.8	24.2
Employment level effect	2.0	1.5	1.2	1.8
Employment type effect	15.5	10.8	8.0	12.7
Skills training effect	4.2	5.6	6.6	5.3
Total	**77.1**	**44.4**	**30.8**	**55.8**

In terms of reducing dropout rates and improving retention, the interventions lead to an increase in years of schooling completed across the whole sample of 1.1 years for girls and 1.3 years for boys. This increase is much higher than the overall average in LICs where years of schooling are low.

A critical variable for the benefits model is the proportion of girls aged 20 to 24 years who complete secondary school. As shown in Table 6.4, the interventions lead to an increase of about 24% in this share with the change relatively common across regions.

One linkage in the benefits model is that higher secondary completions allow adolescents aged 20 to 24 years to access better, formal jobs. Our estimate of the increase in formal jobs held by adolescents by 2050 is quite high, particularly for girls in LICs.

In terms of individual cohort GDP, there are four channels by which that GDP is enhanced:

- the individual productivity effect of years of schooling using extensive, country-specific estimates of the returns to a year of school;
- the productivity value of better quality learning;
- the impact of secondary completions on the type and level of employment; and
- the impact of skills training on productivity.

Table 6.4 shows the model estimates of each of these effects. The productivity of the 20–24-year cohort leaving school around 2050 is estimated to be 47.2% higher for girls and 55.8% higher for boys than the opening cohorts of the early 2020s.

To generate the potential GDP implications of these effects, we tracked the contributions of each cohort out to 2050 as they age until their retirement at 60 years and compared these to the base case levels. These increases in productivity, together with the macroeconomic multiplier and the innovation effect, provide the total increase in GDP arising from the interventions.

6.5.2 Returns to schooling and training

Table 6.5 shows the costs of the interventions. These costs are expressed in billions of dollars as an NPV of annual flows discounted at 3% per annum. For the period 2024 to 2035 inclusive, total costs are US$ 2 311.5 billion, or an average of US$ 192.6 billion per annum over the 12 years.

Table 6.5 **Total additional cost of schooling and training initiatives, by region and country, 64 countries, 2024–35, $ billions**

	Low-income	Lower middle-income	Upper middle-income	Total
Total cost	61.2	419.8	387.2	2 311.5
Average annual cost	5.1	35	32.3	192.6

Table 6.6 summarizes the BCRs for the same selection of countries. The BCRs shown here are the ratio of the NPV, at a 3% discount rate, of total incremental GDP generated by the education intervention programme to that of total costs to 2050. Costs out to 2050 include not only the intervention costs to 2035, shown in Table 6.5, but the costs from 2036 to 2050 that continue from the interventions in place during that period. Total incremental GDP is the total increase in GDP relative to the base, arising from the higher cohort productivity detailed in Table 6.4 and from the macroeconomic multiplier and innovation effects.

We present BCRs on two bases in Table 6.6. One is the arithmetic mean of the individual BCRs for the group of countries considered. This is termed the unweighted BCR; each country, whatever its size, counts as one observation. The other is the ratio of total benefits across a given sample of countries divided by the sum of total costs across those countries. This is termed the weighted mean; the contribution of individual countries to the mean depends on their scale. These measures give different perspectives on the BCR results and preference depends on the purposes for which the BCRs are used.

Table 6.6 **BCRs of investment in interventions in education, 64 countries**

	Low-income	Lower middle-income	Upper middle-income	Total
Unweighted				
Female	41.9	19.3	41.3	31.1
Male	37.3	19.0	35.9	28.4
Both	39.1	18.7	34.8	28.6
Weighted				
Female	34.0	12.7	14.9	14.8
Male	30.4	16.7	16.3	16.8
Both	31.9	14.9	15.7	15.9

Most of the BCRs reported in Table 6.6 are very high and, in most cases, well above 10. The unweighted BCR for all countries is 28.6 (31.1 for females and 28.4 for males) while the weighted BCR for all countries is lower at 15.9 (14.8 for females and 16.8 for males). For the three country groupings, the BCRs are very strong indeed.

7. *Violence and injuries*

7.1 Introduction

In this chapter, we review the evaluation literature related to interventions that address violence and injuries. We acknowledge that there are a number of areas where there is a lack of sufficient evidence to develop investment cases based on cost-benefit analysis. However, for child marriage and road traffic accidents, strong economic cases can be built for investment in intervention programmes to reduce their prevalence.

Violence and unintentional injuries, which includes all forms of inter-personal violence (IPV), injuries (particularly road traffic injuries) and self-harm, has an impact on a large section of the adolescent population (WHO 2023a). Suicide is a leading cause of death among 15-19-year-olds (WHO, 2021b). Child marriages, FGM, intimate partner violence, sex trafficking and sexual violence are all types of violence experienced by young women. Around 30% of children worldwide have experienced some type of bullying, including cyberbullying (UNESCO, 2019). Traffic accidents, gang violence, recruitment into war, terrorism and IPV have a larger impact on young men. Young people from the LGBTIQ+ community face stigma, discrimination, violence and criminalization. The impacts of any type of violence can be long-lasting and intergenerational whilst also incurring high economic costs.

The results of our structured review of intervention evaluations to reduce violence and injuries in adolescents are shown in Table 7.1. This table provides a summary of the investment evaluations employing cost-benefit analysis. There are others such as programmes to prevent intimate partner violence and suicide where the investment case has not been successfully evaluated using cost-benefit analysis. This partly reflects an absence of intervention studies that measure their serious economic impacts, such as school non-attendance or long-term employment loss.

7.2 IPV

Base case estimates by Hillis et al. (2016) indicate that globally over half of all children (one billion children aged two to 17 years) have experienced past-year violence. However, the figure is likely to be higher as much violence goes unreported (UNICEF, 2014). The 1989 UN Convention on the Rights of the Child recognizes freedom from violence as a fundamental human right of children.

Overall, the costs of violence:

- in a range of countries, can be up to 5% of GDP (UNICEF, 2022b);
- for physical, psychological and sexual violence globally can be as high as 8% of GDP (Pereznieto et al., 2014);
- for violence in and around schools that negatively impacts education outcomes can result in an estimated loss of US$ 11 trillion in lost lifetime earnings (Wodon et al., 2021);
- for violence against women, is estimated at US$ 1.5 trillion or 2% of global GDP in 2016 (UN Women, 2016); and
- for child marriage, is estimated at US$ 5 trillion globally from 2014 to 2030 mainly due to increased fertility and population growth, reduced child health and nutrition, education and earnings (Wodon et al., 2017).

Ending child marriage could contribute to welfare gains of over US$ 500 billion per year globally, solely from lower population growth (Wodon et al., 2017).

*Table 7.1 **Summary, benefit-cost ratios for interventions to reduce violence and injuries in adolescents***

Author	Location	Interventions	Benefits	BCR
Rasmussen, Maharaj et al. (2019)	31 countries	Educational interventions, improving life skills, community mobilization and conditional economic incentives to reduce child marriage, improve retention in school, etc of girls	Reduce child marriage, decrease school dropout rates, increase secondary school completions for girls, and address some of the broader social and cultural disadvantage	7.4
Rasmussen et al. (2021)	India	As above	As above	16.8 all interventions 21.0 marriage only 13.1 education only
UNFPA (2022)	70 countries	Testing for least-cost most effective selection of interventions as above	Practical elimination of child marriage by 2030	33.6 optimized intervention selection 11.7 all interventions
This report	70 countries	Education and community programmes to empower girls and reduce child marriage	Reduce child marriage	25.6
UNFPA (2022)	31 countries with high rates of FGM	Legal and policy frameworks and community-led engagement to eliminate FGM	Reducing FGM, health care costs avoided, healthy years of life gained and associated economic and social benefit	10.1
Kuklinski et al. (2021)	24 communities in various states in the United States of America	CTC – provides manuals, tools, training and technical assistance to activate communities	Reducing adolescent substance use, delinquency, and related health and behaviour problems	12.9
WSIPP (2023)	United States of America	PATHS – curriculum promotes emotional and social competencies	Reduces aggression and improves ability to resolve conflicts	24.4
Stelmach et al. (2022)	36 countries	Hospital-based suicide prevention programme School-based suicide prevention programme	Reduce suicide	62 (hospital) 3.5 (school)

This report	77 countries	Broad-based programme to reduce road traffic injuries
		   > infrastructure
		   > alcohol
		   > speed
		   > helmets
			Reducing fatalities and serious injuries	9.1

7.2.1 Causes of violence and proposed intervention strategies

The ecological framework shown in Fig. 7.1 is based on evidence that no single factor can be attributed as the cause of violence. Instead, it is the outcome of the interaction among several factors, working at four levels: the individual, the relationship, the community and the societal. Personal history or biological factors contribute to the individual level and relationships include having violent friends or experiencing domestic violence. Unemployment, population density and related factors contribute at the community level while socioeconomic inequalities, the availability of weapons and social and cultural norms contribute to societal factors (WHO, n.d.).

Several strategies have been proposed for ending violence against children. These include:

■ INSPIRE, which takes into account the above risk factors and includes areas such as norms and values and education and skills (WHO, 2016b; Butchart and Hillis, 2016);

- LIVES, which is a handbook for front-line responders (WHO, 2014); and

- RESPECT (WHO, 2002), which is a framework for interventions (Kerr-Wilson et al., 2020), adopted, for instance, by Ferrari et al. (2022) in their study of IPV.

Fig. 7.1 The ecological framework, examples of risk factors at each level

Poverty
High crime levels
High residential mobility
High unemployment
Local illicit drug trade
Situational factors

Victim of child maltreatment
Psychological/personality disorder
Alcohol/substance abuse
History of violent behaviour

Societal   Community   Relationship   Individual

Rapid social change
Gender, social and economic inequalities
Weak economic safety nets
Poor rule of law
Cultural norms that support violence

Poor parenting practices
Marital discord
Violent parental conflict
Low socioeconomic household status
Friends that engage in violence

Source: WHO (nd).

WHO's Departments of Gender, Rights and Equity – Diversity, Equity and Inclusion (GRE-DEI), Global HIV, Hepatitis and Sexually Transmitted Infections Programmes, and Sexual and Reproductive Health and Research are currently developing a guideline on the health of transgender and gender diverse people. The new guideline will provide evidence and implementation guidance on health sector interventions (WHO, 2023c).

Kerr-Wilson et al. (2020, p3) provided categories of interventions:

- economic interventions such as economic transfer programmes, microfinance and economic empowerment;

- relationship and family-level interventions such as parenting programmes and couples intervention;

- community-level interventions such as approaches to change gender norms, social marketing and edutainment and digital technology; and

- school-based interventions such as preventing dating and sexual violence and preventing gendered peer violence.

7.2.2 ROI – child marriage

A recent systematic review by Malhotra and Elnakib (2021) has provided an assessment of 20 years of intervention evaluations to shed light on their effectiveness in reducing child marriage. The outcome of this work is to emphasize the importance of education interventions, such as CCT or in-kind transfers for schooling support, in enhancing girls' own human capital and employment opportunities. Other interventions that have been successful have included conditional asset transfers for delayed marriage, LST (including gender rights), and, to a lesser extent, community mobilization. Interventions that have had little success include unconditional cash transfers. These have been directed largely at addressing poverty, a factor in child marriage.

Box 7.1 *Estimating the economic and social benefits of reducing child marriage*

This section provides the results from our Child Marriage Benefits Cost (CMBC) model. It summarizes the analysis and assumptions used to estimate the BCR of investing in child marriage prevention in 70 countries. The economic benefits largely arise from increased schooling, leading to greater productivity and formal employment. Prevention interventions encourage greater access to education, especially programmes that reduce dropouts due to early marriage, as well as specific measures to delay marriage.

It was assumed that reducing child marriage rates would result in an increase in average years of schooling and secondary school completion. Increasing the length of schooling leads, on average, to higher lifetime earnings; each additional year of education boosts income. Since the employment benefits of greater education are long-term, benefits were considered up to 2050.

Two scenarios were compared:

- Baseline/business-as-usual scenario developed from the most recent estimates of child marriage based on cohabitation trend rates from household survey data. These were projected from 2024 to 2050.

- Full scale-up, with interventions increasing linearly from 2024 to 2035 and fully implemented to achieve an average 5% child marriage rate for 17-year-olds by 2035. These interventions are then continued out to 2050.

Investments

The cost of preventing child marriage entails funding two sets of intervention programmes. One set, which includes providing economic incentives, life skills and community mobilization programmes, is directed specifically at reducing child marriage. The other is a set of education programmes to keep girls in school, which include improved access to school, girl-friendly schools, better teaching and economic incentives to stay in school.

Benefits

The economic benefits of investing in child marriage prevention arise from:

- education: measures to reduce school dropouts, which were assumed to prevent child marriage and keep more girls in school effectively; and

- formal employment participation and productivity: increased formal employment and greater productivity, which arise from higher levels of education and secondary school completion.

The positive effects on employment were modelled through more accessible education programmes that reduce dropouts that make early marriage much more likely, as well as specific interventions to delay marriage. Reduction of child marriage rates results in an increase in average years of schooling and secondary school completion.

The CMBC model employs the same assumptions as the VEM about the relationship between increased education and productivity gains.

Fig. B7.1 *Modelling framework for child marriage estimations*
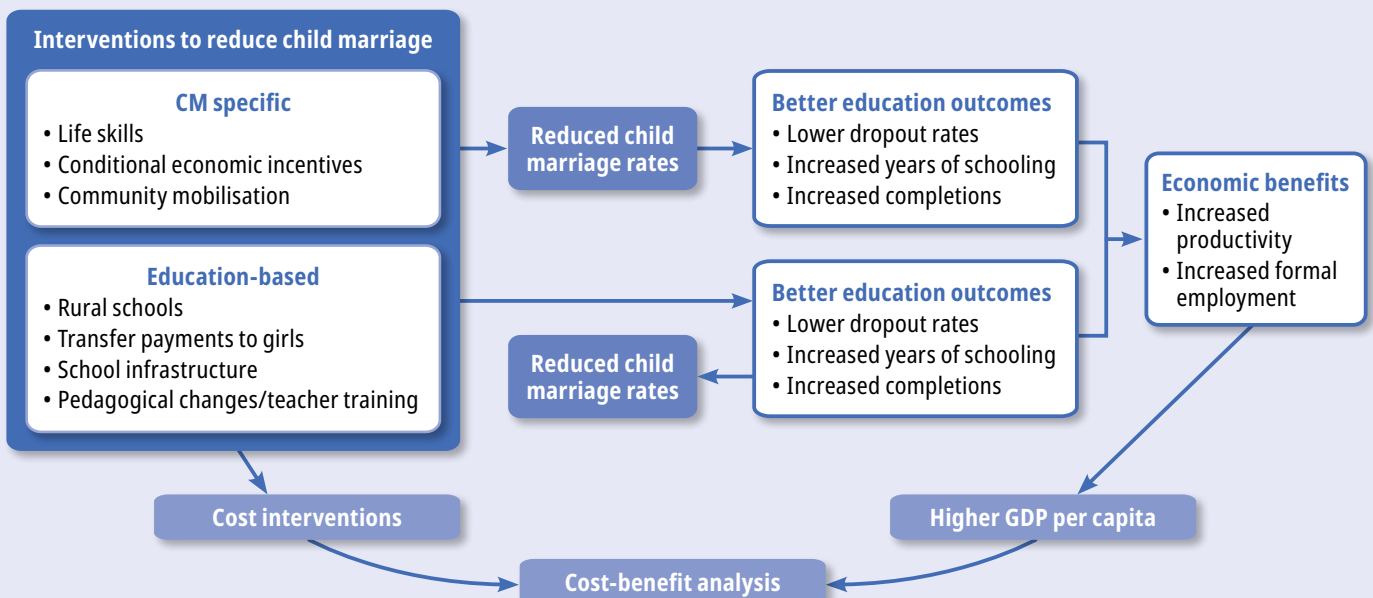
Modelling framework

The modelling framework had several components. First, it used parameters from the literature to estimate the impact of interventions on the child marriage rate as well as intervention costs. Three interventions had direct impacts. Five had indirect impacts through educational interventions that improved school attendance through reduced dropout rates. The interdependence between child marriage and education is illustrated in Figure B7.1. First, increased enrolments tend to reduce child marriage. Second, reduced child marriage increases likely enrolments. Both effects are modelled.

The second step for the direct interventions was to estimate the impact of reduced child marriage on educational outcomes, notably early dropouts, years of schooling and the completion of secondary schooling. This used an education model similar in type and structure to one in Wils et al. (2019). For girls who stay longer in school due to educational interventions, the model assumed that reduced dropout rates occurred in the same proportion among those who would otherwise have been married or unmarried out of school. Country-specific dropout rates were estimated.

A third step was to use the results from the education model in an employment model based on Sheehan et al. (2017). This estimated the economic benefits of better educational outcomes for girls, namely country-specific higher productivity and access to formal employment, leading to higher GDP per labour force participant.

Results

The intervention package for the 70 countries would avert a total of 194 million marriages by 2050. One of the key drivers of success in reducing child marriages is for girls to stay enrolled to complete secondary school. As shown in Figure B7.2, by 2050 101 million additional girls would have completed secondary school.

The total benefits for 70 countries generated by reducing child marriage and increasing time in education equates to total economic benefits of US\$ 7.7 trillion at a cost of US\$ 301 billion. Economic benefits and costs were discounted at 3% per year and are presented in 2022 dollars. The BCR was estimated to be 25.9.

Figure B7.3 illustrates the relative importance of education and community-based programmes. Education programmes are almost half of the benefits, with rural school supply and improved (girl-friendly) school infrastructure being the largest contributors. Community mobilization and life skills

*Fig. B7.2 **Number of school completions before and after the interventions, 2035 and 2050, 70 selected countries***
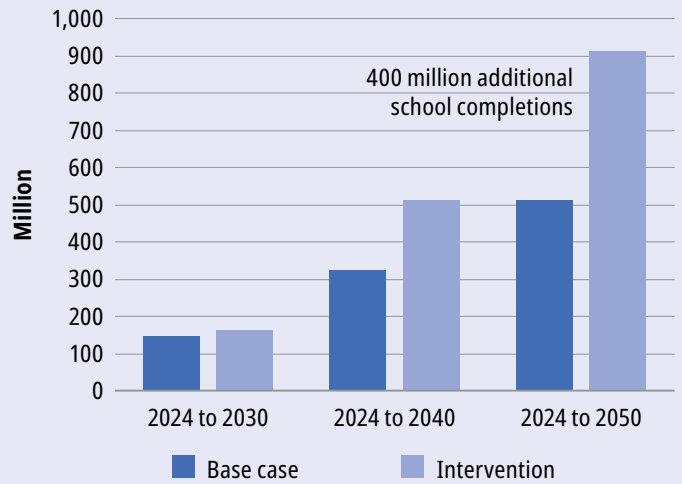
*Fig. B7.3 **Total additional cost and economic benefits of child marriage prevention, US\$ billion, 2024–2050, 70 selected countries***
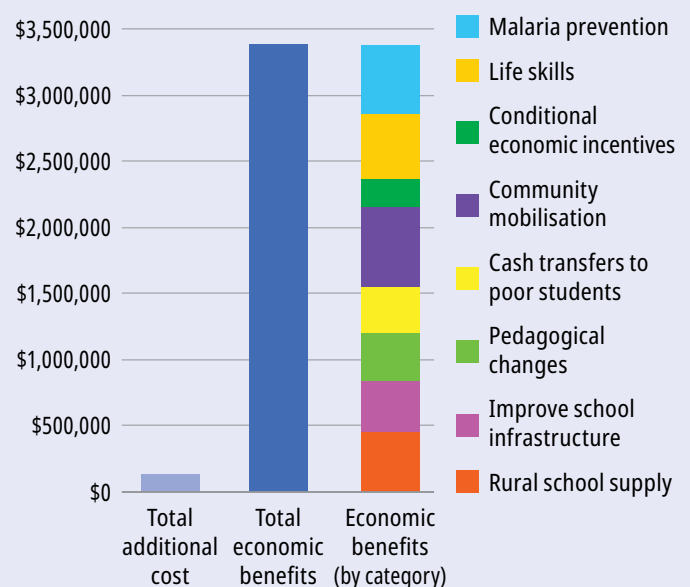
programmes are direct child marriage interventions that address community social and cultural attitudes, and help provide girls with a range of life skills to help delay marriage and transition to the workforce.

Such an intervention programme would have a transformative effect not only on the lives of the girls immediately affected but also on the growth and development of the countries in which they live. The modelling estimates that the intervention programme will avert 194 million child marriages over the period to 2050. The estimated economic and social benefits of reducing child marriage represent about 3% of world GDP.

Source: Modeling estimates, partly based on UNFPA (2022).

The Girls Not Brides evidence review (2023) confirmed how effective CCT can be in keeping girls at school, particularly highlighting the Punjab Government's CCT programme (Mathers, 2021). The review also pointed out the need to ensure that the supply side of girls' education can be as important as the demand side; often girls are unable to stay at school due to poor availability and quality of schools, particularly at secondary levels (Malhotra and Elnakib, 2021). Cohen et al. (2023) argued that educational interventions are not enough to reduce child marriage but need to be bundled with interventions to change social norms.

Favourable job markets can have a positive impact on keeping girls in school (Rose, 2021) as can vocational training in areas including tailoring, hairdressing, catering or carpentry with a view to improving adolescent girls' financial independence (Freccero and Taylor, 2021). Greene et al. (2023) pointed to the need for country-specific studies while Feyissa et al. (2023) indicated that contextual information should be sought before implementing certain incentive-based programmes.

Some strategies combine different interventions. Rasmussen, Maharaj et al. (2019) evaluated the benefits of interventions such as improving life skills, community mobilization and conditional economic incentives that target risk factors to reduce child marriage. They found an average BCR for 31 countries to be 7.4 at a 3% discount rate. Rasmussen et al. (2021) estimated the BCRs of interventions, including CCT, to reduce child marriage in India and found the interventions resulted in an average BCR of 16.8.

In a project for the UNFPA, VISES estimated that to end child marriage, the 70 countries and 13 states in India with the largest numbers of child marriages would need to spend an additional US$ 38 billion from 2022 to 2030 with continued investment thereafter to sustain programming and educate children (UNFPA, 2022). Overall, an additional US$ 151.7 billion would be needed from 2022 to 2050 to continue programming to achieve the practical elimination of child marriage beyond 2030 and to educate children. This aligned with an earlier modelling effort for the UNFPA (2020) using a similar methodology. This estimated the cost but not the benefits of practically ending child marriage for 68 countries over the period 2020 to 2030 to be an additional US$ 35 billion above current programmes.

VISES found that the investment of US$ 151.7 billion would avert 230 million cases of child marriage and help 386 million girls to complete school (UNFPA, 2022). This would have an economic benefit of US$ 5.1 trillion between 2022 and 2050; every dollar spent would give a return of US$ 33.6.

The modelling methodology employed for both UNFPA reports (2020, 2022) included an optimization approach that enabled the least cost and most effective set of interventions for ending child marriage to be selected for each country. Interventions included providing economic incentives, life skills and community mobilization programmes and education programmes to keep girls in school, including improved access to school, girl-friendly schools, better teaching and economic incentives to stay in school.

VISES' most recent modelling of child marriage interventions presented in this report is discussed in Box 7.1. This uses an updated modelling methodology compared with UNFPA (2022) in both optimization and non-optimization forms. The model uses updated baseline data for each country. It also uses a different approach to estimating current child marriage trends, which reduces the baseline projections, prior to interventions, of the decline in child marriage for those countries experiencing declining trends. The implementation period has also been extended from 2030 to 2035. It uses the same set of interventions as UNFPA (2022). These are consistent with the findings of Malhotra and Elnakib (2021) referred to above. However, the range of educational interventions is broader and more comprehensive than those included in their review. In particular, they include infrastructure investments aimed at improving physical access to schools for girls.

7.2.3 ROI – other outcomes of intervention evaluations

FGM

UNFPA (2022) estimated the impact of interventions on FGM cases averted by converting health care costs avoided, healthy years of life gained and associated economic and social benefits. For the 31 high incidence countries, it estimated they would need to spend an additional US$ 2.751 billion to end FGM. The BCR was estimated to be 10.1.

Katz et al. (2021) estimated that reaching the high-coverage targets for 31 countries by 2030 would require an investment of US$ 3.3 billion. This would result in more than 24 million cases of FGM averted at an average cost of US$ 134 per case averted. A moderate-coverage scenario would cost US$ 1.6 billion and avert more than 12 million cases of FGM. The average cost per case averted does not show a substantial variation between countries. The most cost-effective investment found in Katz et al. (2021) was in countries with limited historic change in FGM incidence with the average cost per case averted between US$ 3 and US$ 90. The next most effective would be those with high approval for FGM, but a preexisting trend downward, where the cost per case averted is estimated at around US$ 240.

Intimate partner violence

Several strategies have provided cost-effective rates of return by combining different interventions. For instance, an intervention combining microfinance with gender and HIV training for the prevention of IPV in South Africa was cost-effective in the trial phase (US$ 7688 per DALY gained) and highly cost-effective in scale-up (US$ 2307) even without including the health and development benefits of the intervention beyond IPV reduction (Jan et al., 2011).

The community development programmes SASA! (Abramsky et al., 2016), Safe Homes and Respect for Everyone (Wagman et al., 2015) and TOSTAN (Diop et al., 2004) each had a substantial impact on intimate partner violence (20–52% reductions), but they did not provide BCRs.

Ferrari et al. (2022) provided the cost-effectiveness of interventions in terms of DALYs averted. Their study found that: interventions are more likely to be cost-effective at preventing women's exposure to violence rather than men's perpetration; one-to-one psychosocial support interventions for secondary prevention are likely to be less cost-effective than primary prevention interventions in low-resource settings; and community- and school-based interventions are more likely to be cost-effective from a health sector perspective. Overall, Ferrari et al. (2022) recommended that established community-based interventions to prevent violence against women warrant consideration for immediate scale-up, but should use models that contain costs while developing human resource expertize in LICs and MICs. While Ferrari et al. (2022) did not attempt a cost-benefit analysis, they referenced GDP per capita and willingness to pay as benchmarks to decide on cost-effectiveness, which could be extended to formal cost-benefit analyses.

As discussed in Chapter 3, the AGI-K delivered multisectoral interventions to more than 6000 girls aged 11–15 in two marginalized areas of Kenya, Kibera and Wajir, and comprised a combination of girl, household and community-level interventions. The interventions consisted of community dialogues, CCT, group meetings covering a range of sexual and reproductive health (SRH) and life skills topics and financial education. The aim was to prevent violence against girls and to improve their life and educational skills. The evaluation calculated a monetary benefit of US$ 55 per girl in Kibera and US$ 94 per out-of-school girl in Wajir (Austrian et al., 2020). These figures representing less than the costs did not take into account the qualitative benefits such as confidence, voice and choice for which assigning a monetary value is difficult. Also, with a scaled-up version, there would be a total benefit of US$ 27 783 289, and the relative cost of implementation would be significantly reduced.

Program H, also discussed in Chapter 3, was a gender-transformative curriculum developed for Brazilian young men. It has been adapted in at least 36 countries and was named best practice by the World Bank and WHO. When implemented well and culturally adapted, Program H can lead to changes in attitudes and behaviours related to SRH and IPV (Doyle and Kato-Wallace, 2021). Program H has three interrelated parts: a gender-transformative group education curriculum; community campaigns; and a culturally relevant, validated evaluation model known as the Gender Equitable Men (GEM) Scale that measures the degree to which gender attitudes change as a result of the interventions. Manhood 2.0 was adapted from Program H. The cost of implementing Manhood 2.0 is US$ 4771 per complete round of programme delivery and US$ 451 per participant. The marginal cost per additional round is US$ 3682 (Tang et al., 2022).

IPV

The CTC prevention programme provides manuals, tools, training and technical assistance to activate communities to use advances in prevention science to plan and implement community services to reduce adolescent substance use, delinquency and related health and behaviour problems. The study also looked

at antisocial behaviour, such as being violent and suffering from substance use disorder, during the past year (Hawkins et al., 2008).

The PATHS curriculum promotes emotional and social competencies and reduces aggression and behaviour problems in elementary school-aged children. It is available in several languages including Chinese and French. Several studies have shown that the PATHS curriculum, relative to a control group, results in lower levels of aggression, a better ability to resolve conflicts and many other positive traits. Greenberg and Kusché (1998) and Greenberg, Kusché and Mihalic (1998) estimated that the programme costs for the PATHS curriculum over a three-year period would range from US$ 15 to US$ 45 per student per year, depending on whether the current staff was redeployed or a new on-site coordinator was hired.

WHO, UNICEF and academic partners have developed and tested parenting programmes to prevent violence in low-resource settings, known as Parenting for Lifelong Health (PLH for Teens) (WHO and UNICEF, 2023). After showing positive results in evaluations, the PLH programmes are currently being scaled-up in more than 20 LICs and MICs. Parents are taught alternative parenting strategies to reduce adolescent problem behaviours and avoid harsh disciplining techniques at home. Some parenting interventions in LICs and MICs (McCoy et al., 2020) have positive results in preventing violence against children, but there are no benefit-cost evaluation studies.

The effectiveness of Sinovuyo Teen, one of the PLH for Teens programmes, was evaluated with a cluster-RCT in 40 villages and peri-urban townships in South Africa from 2015 to 2016 (Redfern et al., 2019). The total implementation cost for the programme over the duration of the trial was US$ 135 954, or US$ 504 per family enrolled. Redfern et al. (2019) found that among the 270 families in the treatment group, an estimated 73 incidents of physical and emotional abuse were averted (95% confidence interval [CI] 29 to 118 incidents averted). The total cost per incident of physical or emotional abuse averted was US$ 1837, which the study considered was likely to decrease to approximately US$ 972 if implemented at scale, with an estimated lifetime saving of US$ 2724 minimum per case.

Pepin et al. (2018) quoted Scottish and London models that use the interdisciplinary public health approach to reduce violence. The Scottish model looked at reducing knife crime and the London model looked at youth violence. Another study in Cardiff, United Kingdom of Great Britain and Northern Ireland (Florence et al., 2014) found that the CVPP was highly effective in reducing public violence. This programme involved a violence information-sharing partnership between health services, police and local government. By identifying injury and victim characteristics such as location, time and weapon, police and local government were able to reduce violence-related injuries through preventative programmes. The intervention costs were moderate (IT system and related costs) compared with the sizeable reduction in injuries. The benefits included health and criminal justice system costs avoided and health benefits in terms of QALYs as a result of reduced injuries. Overall, the programme generated a BCR of 82 while the government services study calculated a BCR of 14.80 for the health service and 19.1 for the criminal justice system.

Bullying

Anti-bullying programmes include the Olweus Bullying Prevention Program (OBPP) (Beckman and Svensson, 2015), the bullying prevention programme KiVa (Persson et al., 2018) and the Learning Together intervention (Bonell et al., 2019). The OBPP had a total discounted cost over a three-year period of 4079 Swedish krona (SEK), and it yielded an incremental cost of 131 250 SEK (€14 470) (Beckman and Svensson, 2015). Base-case analysis indicated KiVa leads to an increased cost of €829 for a gain of 0.47 victim-free years per student. In terms of the cost per QALY gained, the results indicated a base-case estimate of €13 823. This may be seen as cost-effective given that it is lower than the typically accepted threshold value in Swedish health policy of around €50 000 (Persson et al., 2018). The mean (standard deviation) total education sector-related costs of Learning Together were £116 (£47) per pupil in the control arm, compared with £163 (£69) in the intervention arm over the first two facilitated years. Overall, although the intervention was associated with higher costs, the mean gain in students' health-related quality of life was slightly higher in the intervention arm. The incremental cost per quality-adjusted life year was £13 284 (95% confidence interval -£32 175 to £58 743) and £63 (£33) and £74 (£37) per pupil, respectively (Bonell et al., 2019).

7.3 Adolescent suicide

Self-harm including suicide, was the second leading cause of death among adolescents according to a study by IHME (2019). However, global suicide rates for adolescents aged 10–19 years declined for both sexes between 2010 and 2019. Overall, during this period, suicide rates for males were higher than for females and declined from 5.27 to 4.42 per 100 000, while for females, they declined from 4.96 to 3.78.

India has the highest suicide rate in the world and over the past two decades has shown a rising trend especially for women (Senapati et al., 2024). The increase in suicide rates among female adolescents has been attributed to several factors that include gender-specific issues, such as gender-based violence, discrimination, and social norms that place a higher burden on females (Senapati et al., 2024).

7.3.1 Causes of suicide

The analysis by Glenn et al. (2020) on worldwide suicide rates found that economic quality or inequality was not related to overall suicide mortality rates, but economic inequality was correlated with a higher ratio of male:female suicides. Renaud et al. (2022) indicated that youth in LICs and MICs continue to be highly represented in suicide statistics yet are underrepresented in the research.

The causes of adolescent suicide have been judged to be exposure to corporal punishment (Cramm et al., 2023); mental health problems; substance misuse; family and other non-intimate relationships; and problems at school (Rice et al., 2023). Rengasamy et al. (2020) found that cyberbullying for younger adolescents was a contributing factor. Wasserman et al. (2021) listed risk factors under different headings, including genetic and neurobiological factors, a family background of psychopathology, personality and cognitive characteristics, stressful life events and poor social relationships. Renaud et al. (2022) listed population-based factors, such as attitudes toward suicide, socioeconomic factors, access to lethal means of suicide and access to mental health care, as contributing to adolescent suicides in LMICs. The individual-based factors for adolescent suicides include psychopathology, negative interpersonal relationships and sexual and gender minorities (Renaud et al., 2022).

7.3.2 Prevention of suicide

Wasserman et al. (2021) categorized suicide prevention strategies according to three different levels, as follows:

(1) Universal strategies that target everyone in a defined population, such as a school, a county and a local community, and are aimed at increasing awareness about suicide and mental health. These strategies remove barriers to care or promote help-seeking behaviours and protective factors such as social support and coping skills. These may also include parenting support, improving education or training opportunities or enhancing conditions in schools or in other settings that are conducive to good mental health.

(2) Selective strategies that address specific groups at increased risk for suicidal behaviour, such as adolescents with mental health problems and harmful use of substances.

(3) Indicated strategies that target high-risk individuals displaying signs of suicidal behaviour.

Universal strategies include those that limit access to lethal means. Gatekeeper programmes teach gatekeepers, such as schoolteachers, how to recognize signs and symptoms of a suicidal crisis and refer identified at-risk subjects to appropriate help resources. Interventions that target specific risk factors such as bullying and substance use disorder have been listed in other sections of this report (for bullying sections 3.1.2, 3.3, 4.1 and 4.4; for substance use disorders sections 4.3.3 and 7.2.3).

7.3.3 Cost-effective interventions to reduce suicide

As discussed in Chapter 4, Stelmach et al. (2022) modelled cohorts of adolescents in 36 countries to assess the impact of addressing adolescent mental disorders and suicide on health and non-health outcomes. They had difficulty finding appropriate studies with relevant data for suicide interventions in their formal search. However, they modelled two interventions: a universal school-based suicide prevention intervention and a hospital-based education and follow-up intervention. Stelmach et al. (2022) found that the targeted hospital-based suicide prevention intervention for adolescents yielded a BCR of 62.0 while the universal school-based suicide programme had a BCR of only 3.5. The school-based intervention was based on the

Saving and Empowering Young Lives in Europe (SEYLE) trial, the effectiveness of which had been reported on by Ahern et al. (2018) and Wasserman et al. (2015).

Ahern et al. (2018) analysed the cost-effectiveness of the Youth Aware of Mental Health (YAM) and other programmes developed for SEYLE. YAM consisted of interactive lectures on mental health and role play sessions on lifetime dilemmas, stress and crisis situations combined with educational posters and booklets. The study found that the YAM programme had the lowest incremental costs per 1% reduction in incidents and per QALY gained versus the control group. The incremental cost-effectiveness ratios reported for YAM were €34.83 and €45.42 per 1% point reduction in suicide attempts and severe suicidal ideation, respectively, and a cost per QALY gained of €47 017 for suicide attempts and €48 216 for severe suicidal ideation. However, the likelihood of the intervention being cost-effective was less than 50%. For suicide attempts, the probability that YAM was cost-effective at a willingness to pay of €47 000 was 39%. For severe suicidal ideation, the probability that YAM was cost-effective at a willingness to pay of €48 000 was 43%.

Wasserman et al. (2015) also studied the three programmes (gatekeeper training [QPR], YAM, and screening at-risk adolescents by professionals [ProfScreen]) that formed part of SEYLE between 1 November 2009 and 14 December 2010. The study randomly assigned 168 schools (11 110 pupils) to interventions, 40 schools (2692 pupils) to QPR, 45 schools (2721 pupils) to YAM, 43 schools (2764 pupils) to ProfScreen and 40 schools (2933 pupils) to the control group. No significant differences between the intervention groups and the control group were recorded at the three-month follow-up. At the 12-month follow-up, YAM was associated with a significant reduction in suicide attempts (odds ratios [OR] 0.45, 95% CI 0.24-0.85; p=0.014) and severe suicidal ideation (0.50, 0.27-0.92; p=0.025) compared with the control group. Fourteen pupils (0.70%) reported incident suicide attempts at the 12-month follow-up in the YAM versus 34 (1.51%) in the control group and 15 pupils (0.75%) reported incident severe suicidal ideation in the YAM group versus 31 (1.37%) in the control group.

Schmidt et al. (2020) undertook a systematic review of health economic evaluations of universal mental health interventions for children and adolescents. Almost half of the studies evaluated the cost-effectiveness of CBT-based interventions, aimed at preventing depression or anxiety, and had mixed results. The cost-effectiveness of a parenting programme (All Children in Focus by Ulfsdotter et al., 2015), a school-based social and emotional well-being programme (PATHS by Humphrey et al., 2018) and anti-bullying interventions (KiVa assessed by Persson et al., 2018) were promising.

7.4 Road safety[8]

Road traffic fatalities and serious injuries for young people are one of the largest causes of death among people aged between 10 and 19 years. In 2022, about 71 000 young people were killed on the world's roads and over 450 000 seriously injured. Of these, roughly 75% were in the 77 lower middle-income countries (LMICs) studied (Fig. 7.2 and 7.3) and of these approximately 80% of the fatalities and 70% of the serious injuries occurred in males. Road fatalities and injuries are much higher for males than females by a factor of three for fatalities and two for serious injuries.

7.4.1 Methodology

This section summarizes the analysis and assumptions used to estimate the BCR of investing in road safety interventions. Two scenarios were compared:

- Baseline/business-as-usual scenario where existing data for each country were used to estimate trends for deaths and serious injuries out to 2050.

- Scale-up of interventions where they increase linearly over the 2024–2035 period to full implementation for all modes.

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8. *Compared with Symons et al. (2019), the BCRs of the more recent modelling reported here are similar but slightly lower than the earlier results with the overall BCR of 9.1 compared with 9.9 in the earlier paper. This is due to a number of enhancements to the model. This has included updated intervention data, inclusion in the model of a rural-urban split and methodological changes, including the projection of current trends. The largest change was to improvements in the granularity of the infrastructure data, including mode specific (pedestrian, bicycle, motorcycle and motor vehicle) infrastructure investment costs for each country.*

Fig. 7.2 *Road traffic injuries and fatalities, 10–19-year-olds, by income group, 2019*

Serious injuries

71,149 (World Bank low-income)
372,535 (World Bank lower middle-income)
128,364 (World Bank upper middle-income)
50,982 (World Bank high-income)

Deaths

16,560 (World Bank low-income)
43,827 (World Bank lower middle-income)
27,087 (World Bank upper middle-income)
8,041 (World Bank high-income)

- World Bank low-income
- World Bank lower middle-income
- World Bank upper middle-income
- World Bank high-income
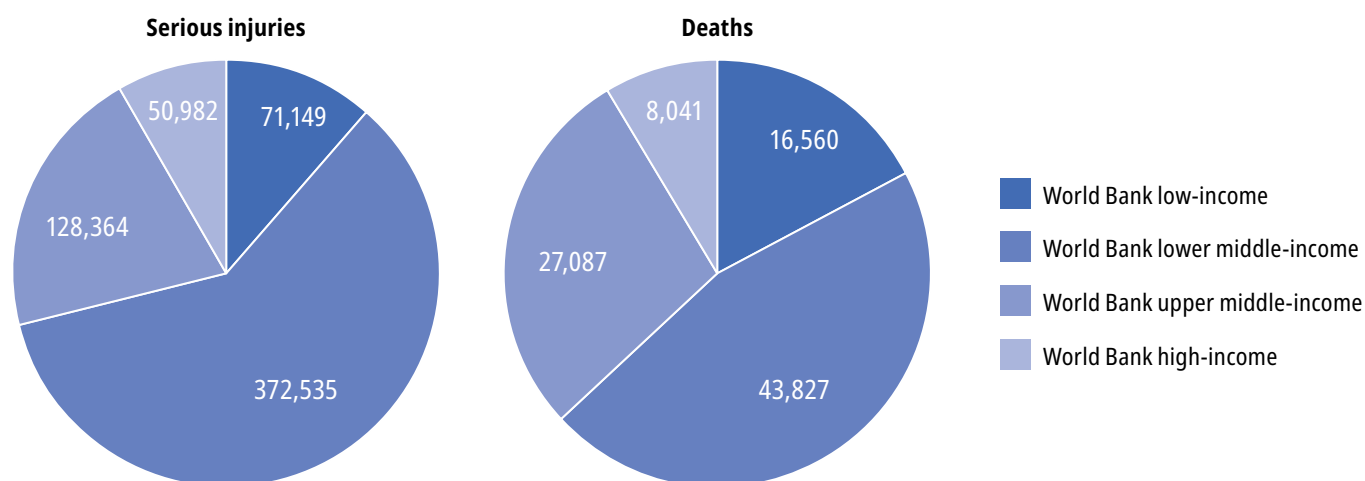
Source: IHME (2019).

As shown in Fig. 7.2, most of the world's adolescent traffic injuries and the largest share of fatalities occurred in LMICs. Of the 623 030 serious injuries, 60% occurred in LMICs and 46% of the total 95 515 deaths for adolescents. While the size of the population is clearly a large factor. in the number of road traffic injuries and fatalities, Fig. 7.3 shows that LMICs also had the highest serious injury rate. However, their death rate (7.0) was slightly lower than the global average of 7.6 per 100 000 population.

Fig. 7.3 *Rates of serious road traffic injuries and fatalities, 10–19-year-olds, by income group, 2019 per 100 000*

Global
World Bank low-income
World Bank lower middle-income
World Bank upper middle-income
World Bank high-income

- Fatalities
- Serious injury
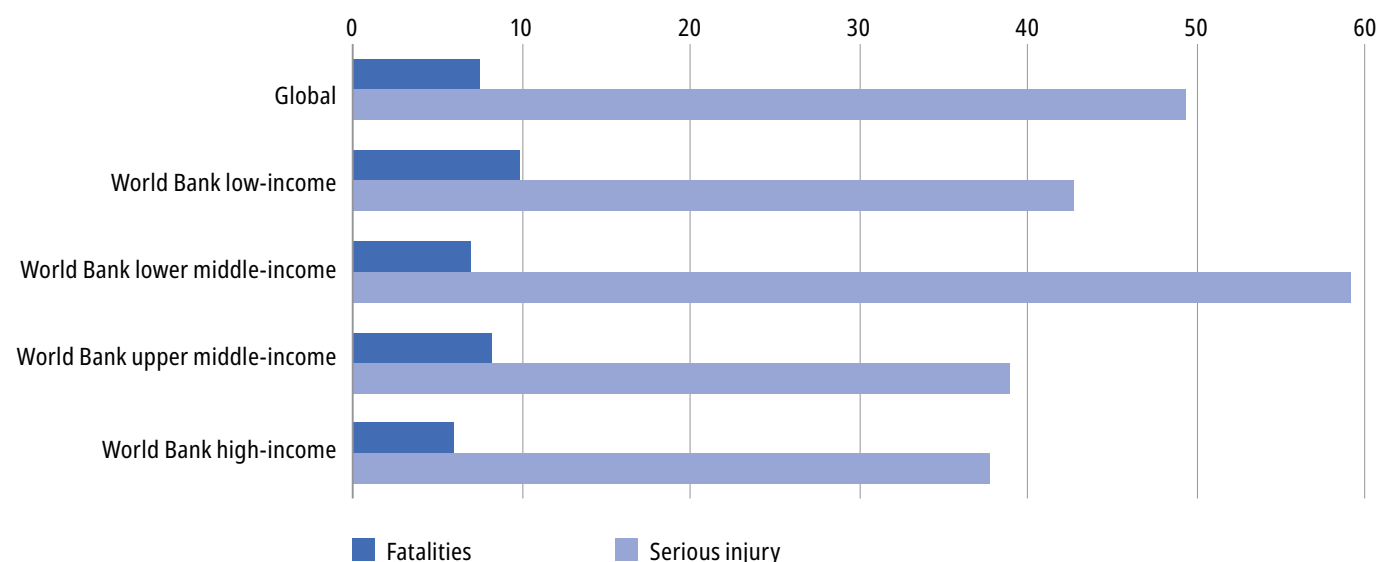
Source: IHME (2019).

7.4.2 Investments

The cost of reducing road traffic deaths and serious injuries includes funding two sets of intervention programmes. One set includes behavioural measures focused on alcohol and speed compliance, seat belt enforcement, helmet wearing for motorcycle riders, road safety campaigns as well as graduated licensing schemes for motorcycle riders and motor vehicle drivers. The other set addresses physical changes, including improved infrastructure and policy programmes to encourage safer motor vehicles.

7.4.3 Benefits

The benefits involve reducing deaths and serious injuries with corresponding economic benefits calculated by following the cohort of people over their lifetimes whose deaths or serious disabilities are averted for each year of the intervention programme. As the period of the intervention is from 2024 to 2050, there are 27 such cohorts.

7.4.4 Modelling framework

The modelling framework (Fig. 7.4) builds on the studies of Chisholm and Naci (2012) who undertook modelling for LICs and MICs at a regional level. The framework involves estimating deaths and serious injuries from road accidents by age, gender and mode (pedestrian, cyclist, motorcyclist, motor vehicle occupant) in an unchanged policy base case and compared with one achieved through systematic implementation of the range of interventions identified above.

Fig. 7.4 Modelling framework
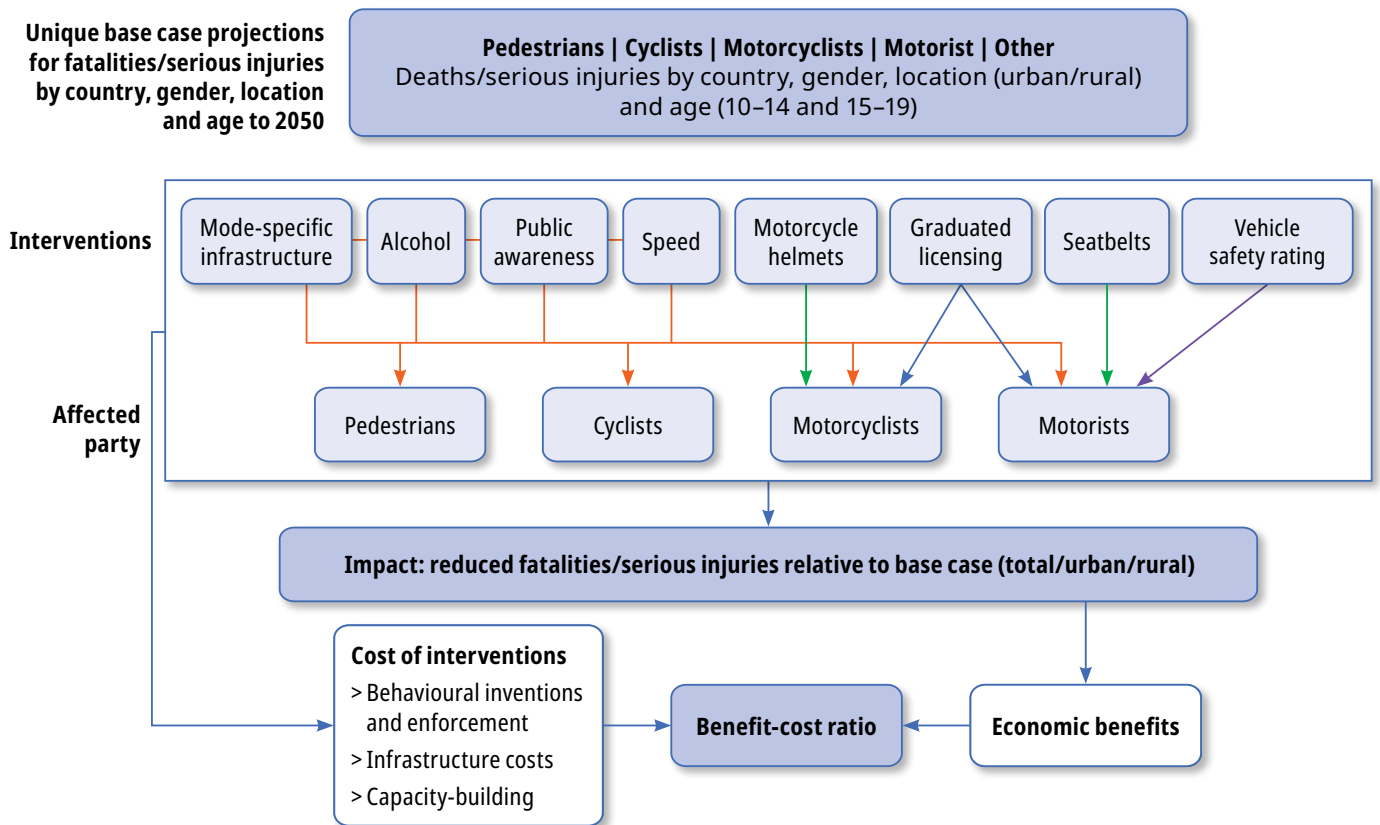
Establishing a base case projection of deaths and serious injuries from road accidents for the 77 countries out to 2050 is a complex task. Different transport modes have different accident rates (for example, motor cars are safer than motorcycles). However, the starting point used in the modelling framework for the base case was the matrix of fatality rates (deaths per 100 000 population) from 2010 to 2019 by age, gender and accident type. An exponential trend line was then calculated from the years 2010 to 2019 and extrapolated out to 2050 for each of the different fatality rates. A similar approach was taken for estimating serious injuries, which were assumed to be a subset of injuries, the ones that cause serious and permanent injurie preventing the person from working or attending school.

The population of each country varies over time in line with the ILO population projections. However, the matrix of fatality rates remains fixed for each group within each country. The base case data of fatality rates by age, gender and mode or injury type are from the GBD 2019 data (IHME, 2019). Two age cohorts (10–14 and 15–19 years) were used for the following types of injured persons or fatalities: pedestrian, cyclist, motorcyclist, motor vehicle occupant and other categories. This produced 20 baselines (age cohort * gender * transport mode) for each of the 77 countries.

After reviewing the literature, effective interventions to reduce road accidents and estimates of their cost and effectiveness in reducing deaths and serious injuries for young people in the 77 countries were identified. These estimates were used to calculate the reduction in deaths and serious injuries achieved in each of the 77 countries relative to the base case. The interventions are assumed to be independent but with multiplicative effects. However, the effectiveness value for particular interventions varies between countries as different circumstances apply. For example, the effect of alcohol enforcement is obviously reduced in Islamic countries where the consumption of alcohol is restricted. In addition, some countries already have interventions in place, but the level of implementation or enforcement across those countries might vary significantly. This is evident in such data as the WHO estimates of the different levels of helmet wearing and seat belt usage across the globe.

The benefits arising from the interventions are the economic and social costs of road accidents avoided because of the reduction in accidents. The analysis focused only on the avoided deaths and serious injuries involving severe and profound impairment, such as to preclude employment. Two types of benefits arise from fewer deaths and serious injuries: increased employment and productivity leading to higher GDP and the social benefits of each healthy life, over and above the benefits of higher GDP through increased labour force participation.

The number of people who are in the labour force was calculated by using labour force participation rate projections from the ILO (2023). For each year and age and sex cohort, the number of people in the labour force was calculated by applying the labour force participation rate estimate appropriate for each estimate of the number of people in that year by age and sex.

The economic contribution from these people in the labour force was calculated by multiplying the number by an estimate in that year of the GDP per person in the labour force and a factor estimating the productivity of their age compared to average productivity.

The results for each cohort are their contribution to GDP each year in which they are in the labour force. Summing across all the cohorts gives a measure of the GDP resulting from the deaths and serious disability averted by the intervention programme. The increased GDP and social benefits arising from these reductions enable the calculation of BCRs.

7.4.5 Results

The implementation of the interventions would result in approximately 49% of the projected deaths and 46% of serious injuries being averted between 2023 and 2050 (see Table 7.2).

The interventions to achieve these reductions in deaths and disabilities were estimated to have an NPV (3% discount rate) of US$ 104.8 billion with a total benefit of US$ 954 billion (see Table 7.3). Fig. 7.5 shows the costs and benefits disaggregated by income status and gender.

The contribution of each intervention is summarized in Fig. 7.6, which highlights the importance of alcohol and speed compliance as well as improved infrastructure.

Table 7.2 **Projected deaths and serious injuries due to road traffic accidents in adolescents, 77 countries, 2023–2050**

	Total	Low-income	Lower middle-income	Upper middle-income
Deaths	1 778 830	559 513	883 584	335 734
Deaths after interventions	905 142	273 630	451 180	180 332
Averted deaths	**873 688**	**285 882**	**432 404**	**155 402**
Serious injuries	13 172 423	3 092 431	7 442 702	2 637 290
Serious injuries after interventions	7 090 626	1 574 823	3 964 648	1 551 155
Serious injuries averted	**6 081 797**	**1 517 608**	**3 478 054**	**1 086 135**

Table 7.3 Estimated costs and benefits of investment in road safety interventions for adolescents, net present value, 77 countries, 2023–2050, weighted BCRs, $ million

Deaths	121 778
Disability	833 053
Deaths plus disability	954 831
Cost, million dollars (NPV)	104 821
BCR deaths	1.2
BCR disability	7.9
BCR deaths plus disability	9.1

Fig. 7.5 Estimated BCRs of investment in road safety interventions for adolescents by gender, 77 countries, 2023–2050
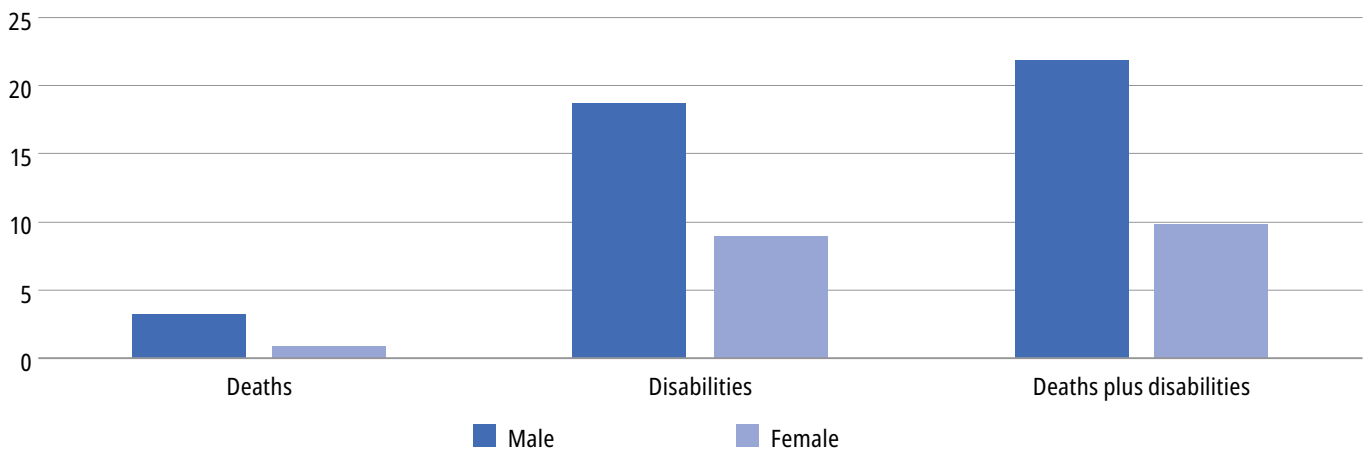
Fig. 7.6 Costs, benefits and intervention type, road traffic fatalities and serious injuries, adolescents, $ million. LHS is left hand axis, RHS is right-hand axis
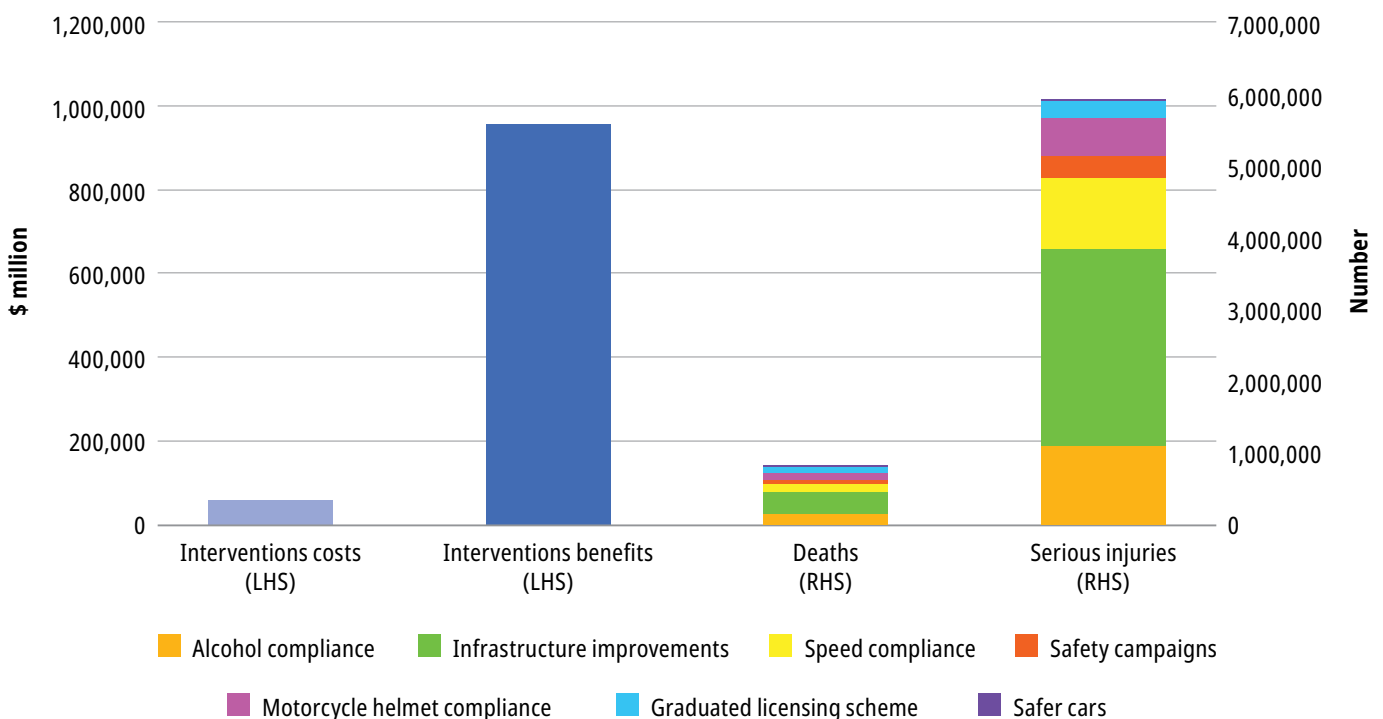
7.5 Conclusions

The strategies discussed above have sought to address some of the types of violence perpetrated against adolescents, such as bullying, child marriage and IPV. The strategies are based on frameworks such as INSPIRE and RESPECT, targeting harmful norms and values, providing income support or providing parent and caregiver support and improving education and life skills. These are delivered via the three platforms of health, schools and community settings. Most need to be adapted to the needs of different countries.

The contribution to the investment case made by these interventions is relatively small. However, beyond measuring and quantifying the costs and benefits in monetary terms, interventions are needed to make sure the basic human rights of adolescents to be free from violence are upheld.

Evaluations adopting cost-benefit analyses have been successful in demonstrating the economic impact of interventions to reduce child marriage in addition to highlighting their important social and cultural role in changing the environment for adolescent women and girls. The most recent modelling presented in this chapter shows the huge potential economic impact of delaying marriage and enabling their continued schooling. As projected, this could result in another 101 million girls completing school in the period to 2050. This equates to another US$ 7.7 trillion of GDP in present value terms, largely for the LICs and LMICs included in the analysis. These economic impacts provide the basis for a BCR of 25.9.

Deaths and serious injuries from road traffic accidents are a major issue for young people, but especially for young people in LICs and MICs, with over 70 000 10–19-year-olds being killed and over 450 000 being seriously injured in 2022. These deaths and serious injuries can be addressed by interventions that have been broadly accepted in the literature as effective and have been well-developed in HICs. This study has shown that implementing these interventions represents a very good economic and social investment with BCRs at a 3% discount rate of 9.1. This would be achieved through the prevention of 870 000 deaths and 6 million serious injuries from 2023 to 2050 with more male than female deaths and serious injuries averted due to the much greater initial rates for males.

Evidence of successful, cost-effective interventions to address suicide is limited, especially outside UMICs. The Stelmach et al. (2022) study found that the BCR for a universal school-based programme based on the findings of Wasserman et al. (2015) and Ahern et al. (2018) is a relatively low 3.5. A targeted hospital-based suicide prevention intervention for adolescents yielded a much higher BCR of 62.0.

8. *Financing the investment in adolescent well-being*

The cost of the investment programme for adolescents discussed in this report for the period to 2035 is US$ 2.8 trillion in NPV terms, averaging about US$ 230 billion per annum. The largest component is for education interventions at approximately US$ 2.3 trillion. Health follows at about US$ 40 billion and the remainder includes interventions to address child marriage and road accidents, all in NPV terms. The large component of the total expenditure on education emphasizes its role in addressing multiple aspects of adolescent well-being. This investment in adolescents would form an important component of the SDGs. While almost all of the SDGs have some relevance to the well-being of adolescents, achieving SDG 3 (good health and well-being) and SDG 4 (quality education) for adolescents absorbs a large share of the investment required to achieve the well-being outcomes contemplated in this investment case. This means that the task of financing this investment case for adolescents is a component of the one to finance the SDGs; they share the same challenges.

Financing social development programmes for LICs and LMICs has never been easy. In addition to the typically modest domestic capacities, a significant proportion of investment in social development, such as health and education, has come from foreign sources in the form of aid programmes and external borrowings. For instance, in LICs, the share of total health spending derived from external funding is 31% (WHO, 2023d), and 13% of education expenditure is official development assistance (ODA) (World Bank, 2023c). For many developing countries, investment from China through the Belt and Road Initiative has been largely in physical infrastructure. While this may have had the effect of freeing up domestic revenue sources for investment in social programmes, for most countries, there has been very little Chinese investment in social expenditure, such as schools and health facilities.

For the last decade, both ODA and World Bank loans and credits have grown at a solid rate. Western foreign aid, as represented by Development Assistance Committee members, increased from US$ 246.1 billion in 2012 to US$ 335.4 billion in 2021, equating to a compound annual growth rate of 3.5% and increasing as a share of the global GDP from 3.3% to 3.5%. The rate of growth was increased by a spurt of COVID-related funding between 2019 and 2021. Prior to 2020, it had been growing at 2.8% per annum. Reflecting the demands of the COVID-19 pandemic, ODA grew at 6% per annum from 2019 to 2021 with an increase of US$ 9.0 billion in social infrastructure expenditure between 2020 and 2021 (OECD.Stat, 2023).

World Bank lending (International Bank for Reconstruction and Development [IBRD]) loans and International Development Association [IDA] credits) to LMICs increased at 4.9% per annum, in current US dollars, over the period 2012 to 2021, with a COVID-19-induced lift of 10% between 2020 and 2021. Prior to that, from 2012 to 2019, World Bank loans were growing at an average annual rate of 4.4% (World Bank, 2023e). Overall, this would suggest that both Western foreign aid and World Bank lending, while not at the levels required to achieve the SDGs, were increasing in line with world economic growth.

For many LICs and LMICs, external borrowings, including those that are at concessional interest rates, are often burdensome. As outlined by the UN Global Crisis Response Group (2023), several factors in the post-COVID-19 world have added to the existing challenges. The level of borrowing is at its highest level. As shown in Figure 8.1, total public debt for developing countries as a share of GDP has risen from 35% to 60%, and the external public debt share of GDP increased from 19% to 29% over the period 2010 to 2021. Developing countries have been adversely affected by both falling currency values and rising interest rates. External debt servicing as a share of export income almost doubled, increasing from 3.9% to 7.4% over the same period (UN Global Crisis Response Group, 2023).

This increasing debt-servicing load has an impact on available resources for other public expenditures. As a share of government revenues, interest payments rose substantially for developing countries from 4.2% in 2010 to 6.9% in 2022 and have been growing more rapidly over the past decade than expenditure on health and education.

The number of countries with a debt servicing load of over 20% of government revenues reached 25 in 2022; a number not seen since 2000 (UN, 2023a). Developing countries have sourced an increasing share of their financing requirements from private creditors, which is not only more expensive than doing so from international banks that lend on potentially concessional terms but such creditors are harder to negotiate with should debt restructuring be necessary.

The additional funding required to finance the SDGs therefore coincides with reduced domestic financing capacity in developing countries. Moreover, the modest rates of growth of ODA and World Bank lending are less than that required to meet the SDGs. Both suffer from constraints to substantial increases in funding. A substantial lift in ODA is constrained by high indebtedness and fiscal constraints for HICs.

Fig. 8.1 *Developing countries' increasing external public debt, median values for developing countries, 2010–2021*
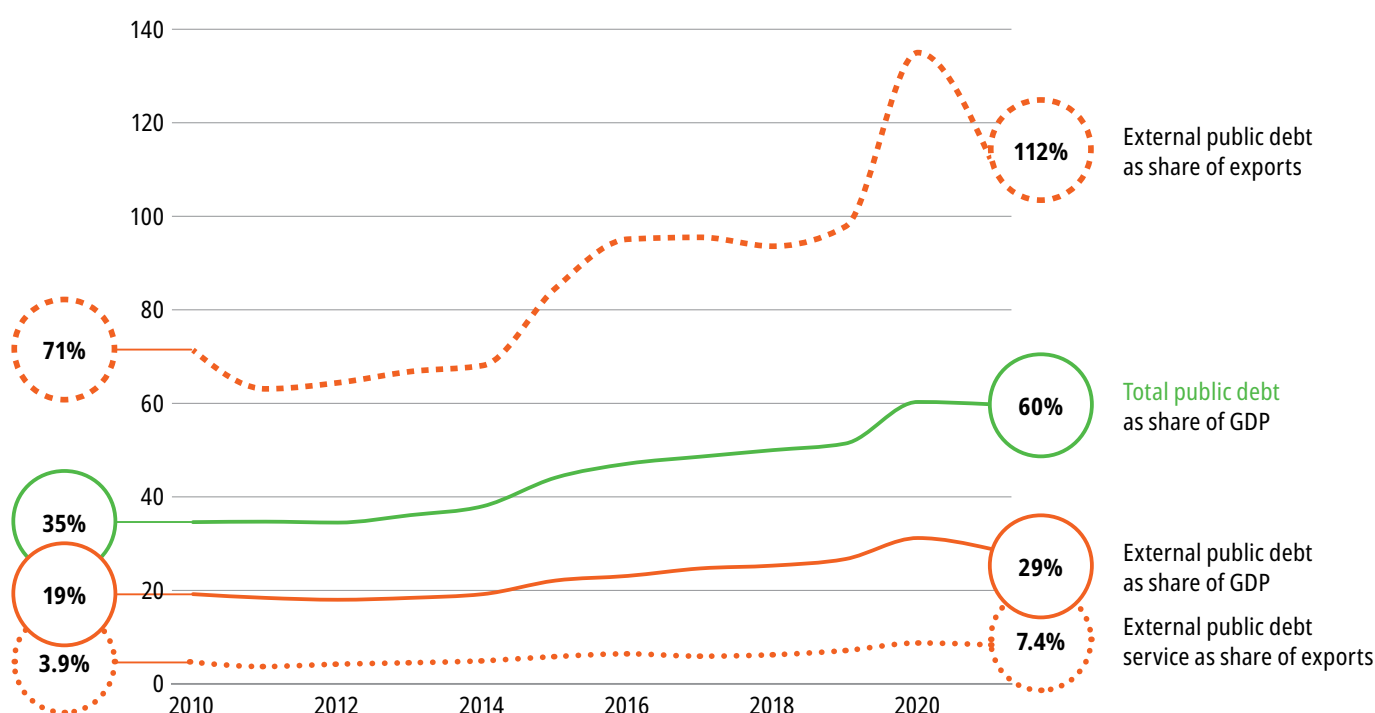
Notes: Total public debt refers to general government debt. External public debt refers to external public and publicly guaranteed debt. Source: UN Global Crisis Response Group (2023, p9).

Lending by the World Bank and other development banks is constrained by real declines in their capital. As a share of world GDP, the current value of contributed capital to the World Bank and other development banks is a fraction of the amount given when they were first established. For the World Bank, the current amount contributed equates to approximately half of its level in 2000 (UN, 2023a). The World Bank would require a massive increase in contributed capital to return its lending capacities in real terms to these earlier levels.

The UN has developed a set of reforms for the world development financing structure to help meet the requirements of the SDGs and other sustainability objectives associated with climate change. These are grouped under three action areas with 17 specific reform proposals (UN, 2023a, 2023b). The three action areas are:

1. tackling the rising risks of debt distress and the high cost of public debt;

2. massively scaling-up affordable and long-term financing for development; and

3. expanding contingency financing to countries in need.

In financial terms, the most far-reaching of these is the proposal to increase the paid-in capital of the four main development banks, IBRD (World Bank), African Development Bank, Asian Development Bank and the Inter-American Development Bank, by between US$ 47 and US$ 148 billion from a total of US$ 47 billion. This is estimated to provide between US $487 billion and US $1.86 trillion in lending capacity, based on a lending multiplier of 10–12 times capital (UN, 2023a, p.9). This would be combined with improved lending terms for LICs and a better approach to blended finance with the private sector.

Other reforms include improved liquidity arrangements for countries in immediate need and longer-term reforms to the sovereign debt architecture that would improve the focus of international lending arrangements on achieving the SDGs and other climate change related funding objectives. In its more detailed discussion of the reforms, the UN (2023b) addressed the need to stem the flow of illicit income from developing countries and introduce measures to reduce tax avoidance to protect the domestic revenues generated by multinational corporations. For some resource-rich developing countries, this is a major cause of lost revenue.

The agenda of reforms outlined by the UN indicates that the issue of funding the SDGs is very much a focus of its support to Member States to achieve those SDGs. The aims of the initiatives evaluated in this report are consistent with the SDG targets and programmes recommended by the UN.

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Annex 1. Additional methodological details and tables related to Chapter 1

This Annex provides further methodological detail on three aspects included in the main report: measuring the costs of inaction (see Section 1.3.1), the extent to which the models used have been validated by external reviews (see Section 1.3.2) and the methodology for health services modelling (see Section 1.3.3). It also includes an additional Table A1.7 related to Chapter 1 of the main report.

1. The cost of inaction

1.1 Measuring the costs of inaction

In this section we provide details of the methodology used to estimate the cost of inaction, which is the cost of failing to take action to address the challenges facing adolescents and to improve their well-being.

There are several possible approaches to this question, which in turn provide different interpretations of the cost of inaction. For example, one might estimate the economic and social loss arising from any death or morbidity for adolescents over a given period (or the loss arising from of a more broadly defined set of diminutions of adolescent well-being). This approach measures, for example, the loss from any deaths or morbidity for a given group of adolescents but does not tie the estimate to any failure to take action to avert these deaths or this morbidity. It measures the loss from a given level of mortality or morbidity, rather than losses arising from a specific failure to act.

For the present study, we take an approach that focuses squarely on the costs of <u>inaction</u>. We estimate the opportunity costs incurred by failing to intervene, in the ways specified in the report, to improve adolescent well-being over the period in question. The costs of inaction are those of failing to intervene and hence of failing to achieve the estimated benefits.

1.2 Implementing an opportunity cost approach

In implementing this approach, it is important to note that the period of inaction – the period during which the interventions are not undertaken – is different from that in which the costs are incurred. Because many interventions have long-term benefits, over the full working life or even over the lifetime of the individual involved, the period of implementation is conceptually quite different to that in which the costs are incurred.

There are several complexities involved in giving effect to the opportunity cost approach. The first complexity is that there are two different types of intervention considered in the report, discrete and extended. One type of intervention (such as a health treatment or a vaccination) is implemented at a discrete time, even though its benefits may accrue well into the future. The second type covers interventions that take place over an extended period, such as in the case of interventions to improve school retention and the quality of learning. Such interventions may take place over a period of 5–6 years, as improved teaching in a better context takes place over the student's years of attendance at secondary school.

For this reason, there are two modelling variants included in the overall report, as follows:

(i) In areas where there are mainly discrete interventions, the interventions are scaled up progressively from base case levels in 2023 to target levels by 2035, and then cease. These include the four sets of health interventions (health services, HPV, TB and myopia).

(ii) For the extended intervention areas (education and learning, road safety and child marriage), the interventions are again scaled up progressively from base case levels in 2023 to target levels by 2035 but are held at that effective level through to 2050. This means that the effect of the interventions is held at their level in 2035 through to 2050. This will require continued investment to maintain them at the 2035 level but will not require further investment in incremental programs.

The cost of inaction reported here is the gross cost of inaction. That is, it does not take account of the investment necessary to reap the benefits. In calculating benefit-cost ratios (BCRs) for each type of intervention, the full costs are included in the denominator.

For each of the intervention areas noted below, we construct a base case (broadly the consequences of existing policy settings) and an intervention case (broadly a set of interventions that are scaled up over time to 2035 and then, for the extended interventions, maintained at that level until 2050). Using epidemiological or other subject-specific models to estimate the human impact of the interventions and an economic model to value those impacts, we derive an estimate of the economic and social benefits of the intervention outcomes relative to those of the base case. The costs of inaction are the economic and social costs incurred by failing to take action to implement the interventions.

We have applied this approach to the following areas:

- health (adolescent health services, HPV, TB, myopia);

- education, training and skills;

- child marriage; and

- road safety.

Insufficient information is available to extend this approach to other areas covered in the report.

1.3 Specific methods and results

The key specific aspects of the methodology are as follows:

- We express the costs of inaction as described above as net present values, at a 3% discount rate of flows over the 27 years 2024–50.

- For interventions of the discrete type, which are only modelled to 2035, we make the minimal assumption that, if the interventions were continued at the 2035 level out to 2050, the additional benefits to new cohorts subject to the interventions will be at least equal to those received by the 2024–35 cohorts.

- The country coverage of the interventions varies across the seven areas shown above, but in most areas of intervention, coverage rates are at or above 80% of the global population.

- For this reason, we use as our gross domestic product (GDP) comparator the GDP of emerging market and developing economies, as defined and estimated by the World Bank. Given the much lower per capita GDP in these countries than in developed nations, the emerging market and developing countries share of global GDP is 41.7%.[1]

- The starting figure for estimating long-run GDP is projected GDP in this region in US\$s in 2024. This figure is assumed to grow by 4% in real terms per annum out to 2050. The resulting GDP flow is expressed as a net present value, in 2024 and at a discount rate of 3%, to give the net present value (NPV) of estimated GDP in emerging market and developing economies over the 27 years 2024–50.

- This total NPV is divided by 27 to get the average annual GDP of this region over 2024–50, again expressed as an NPV in 2024 US\$. This figure is US\$52.5 trillion.

- On the same basis, the estimate of the average annual cost of inaction (benefits foregone) over 2024–50 is US\$4.1 trillion per annum.

- This gives the estimated average cost of inaction as 7.7% of GDP, as indicated in the report.

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1. *https://www.imf.org/external/datamapper/NGDPD@WEO/ADVEC/WEOWORLD/OEMDC*

2. Validation of models

The full report utilizes eight models, developed by the report writers and their collaborators, to calculate impacts, costs and benefits, and hence to estimate the benefit-cost ratios for the various classes of interventions. Of these models, five are established models which have been progressively developed and improved over time, while three are newer models, which have not as yet been used in peer-reviewed journal articles. The status of these models is reviewed in Table A1.1.

Table A1.1 Origins, development paths and validation status for eight benefit-cost models used in this report

Model area	Origin and development	Validation by journal reviewers
Established models		
1. Adolescent health services model	Built for Sheehan et al. (2017) and reported in Sweeny et al. (2019). For this application there has been full re-estimation of OneHealth Tool (OHT) results with updated cost and economic components. See Chapter 2, section 2.1.	Reviewed by eight external reviewers for the two publications cited (The Lancet and the Journal of Adolescent Health).
2. Education and training	Built for Sheehan et al. (2017) from earlier work by UNESCO and UNICEF; reported in Wils et al. (2019). Here the model has been re-developed, retaining the basic structure of transition through grades. Upgrades include a new meta-analysis for effect sizes and the grouping of related interventions. See Chapter 6, section 6.2.	Reviewed by eight external reviewers for the two publications cited (The Lancet and the Journal of Adolescent Health).
3. Improved productivity and employment	Built for Sheehan et al. (2017); reported in Sheehan and Shi (2019). Modest macroeconomic multiplier and innovation effects have been added, but otherwise the values from the 2019 paper have been used. See Chapter 6, section 6.4 and Table 6.3.	Reviewed by eight external reviewers for the two publications cited (The Lancet and the Journal of Adolescent Health).
4. Prevention of child marriage	Initial modelling reported in Sheehan et al. (2017) and Rasmussen, Maharaj et al. (2019 and 2021) with further development in UNFPA (2022). The model used here now includes 70 countries with updated data inputs and effect size estimates. An optimization facility is also available.	This model was substantially developed beyond the initial work for Sheehan et al (2017), with revised versions subject to peer review for the 2019 and 2021 publications. But the final version used here has not been reviewed.
5. Road traffic injury prevention	Initially developed for Sheehan et al. (2017); see also Symons et al. (2019). Further enhanced since then with support from the FIA Foundation (Symons et al., 2022). For changes see Chapter 7, section 7.4.	Base model reviewed by eight external reviewers for the two publications cited (The Lancet and the Journal of Adolescent Health).
New models		
1. HPV	While an earlier model was used for Sheehan et al. (2017), a new model was built jointly with the Daffodil Centre, University of Sydney and Sweeny, Nguyen et al. (2023). See Chapter 2, section 2.2.	The new model has not yet been sent for external review.
2. TB prevention and treatment	This new model estimates the BCR from implementing the WHO End TB Strategy in 50 countries (95.7% of adolescent TB deaths). See Chapter 2, section 2.3.	The new model has not yet been sent for external review.
3. Myopia screening and treatment	This new model uses inter alia evidence from The Lancet Global Health Commission on Global Eye Health (Burton et al., 2021). See Chapter 2, section 2.4.	The new model has not yet been sent for external review.

In addition to extensive review by expert reviewers for leading journals, these models have been constructed and developed in conjunction with experts in individual subject areas. They have also been used in studies for international agencies and other organizations, such as UNFPA (1, 2 and 3), UNICEF (4, 5) and FIA Foundation (6) (see Box A1.1).

Box A1.1 VISES reports and other papers

1. Rasmussen, B, Maharaj, N. et al. Cost of ending child marriage. In UNFPA. Costing the three transformative results. New York: United Nations Population Fund; 2020, chap. 4. (https://www.unfpa.org/featured-publication/costing-three-transformative-results, accessed 15 May 2024).

2. UNFPA, Avenir Health, Johns Hopkins University, Victoria University. Impact of the COVID-19 pandemic on family planning and ending gender-based violence, female genital mutilation and child marriage. Interim technical note. New York: United Nations Population Fund; 2020. (https://www.unfpa.org/resources/impact-covid-19-pandemic-family-planning-and-ending-gender-based-violence-female-genital, accessed 15 May 2024).

3. Sweeny, K, Nguyen, DTN, Simms, K, Keane, A, Bateson, D, Canfell, K. An investment case study on HPV vaccination in Viet Nam. Hanoi: Ministry of Health (Viet Nam) and UNFPA Hanoi; 2023. (https://vietnam.unfpa.org/en/publications/investment-case-study-hpv-vaccination-viet-nam, accessed 20 February 2024).

4. Rasmussen, B, Sheehan, P, Symons, J, Maharaj, N, Welsh, A, Kumnick, M. Syria education and development investment case: economic, social and psychological costs and risks resulting from not investing in education systems in Syria. Report to UNICEF Syria. Melbourne: Victoria University; 2022. (https://content.vu.edu.au/sites/default/files/adolescents-education-syria-report.pdf, accessed 20 February 2024).

5. Rasmussen, B, Sheehan, P, Sweeny, K, Symons, J, Maharaj, N, Kumnick, M, et al. Adolescent investment case Burundi: estimating the impacts of social sector investments for adolescents. Report to UNICEF Burundi. Melbourne: Victoria University; 2019. (https://vuir.vu.edu.au/40741, accessed 20 February 2024).

6. Symons, J, Sweeny, K. Development of the investment case to reduce road traffic injuries among adolescents. London: FIA Foundation; 2022. (https://www.fiafoundation.org/media/iyjfnfaj/final-report.pdf, accessed 20 February 2024).

3. Detailed methodology for health services modelling

This section describes the methodology and assumptions used in modelling a range of adolescent health interventions using the OneHealth tool (OHT).

3.1 Introduction

This section reports on the modelling of 95 adolescent health interventions using the OHT in 40 low- income countries (LICs) and middle-income countries (MICs). The countries included in the modelling, which account for more than 80% of the global adolescent burden of disease, are listed in Table A1.2, along with their current World Bank income status (World Bank, 2023a). The group consists of 13 Low-income countries (LICs), 17 lower middle-income countries (LMICs) and ten upper middle-income countries (UMICs). The results from the OHT modelling are then used in an economic model to undertake a return on investment (ROI) analysis.

Table A1.2 Countries included in OHT modelling, income status

Afghanistan	Low-income	Mali	Low-income
Angola	Lower middle-income	Mexico	Upper middle-income
Bangladesh	Lower middle-income	Mozambique	Low-income
Brazil	Upper middle-income	Myanmar	Lower middle-income
Burkina Faso	Low-income	Nepal	Lower middle-income
Cameroon	Lower middle-income	Niger	Low-income
China	Upper middle-income	Nigeria	Lower middle-income
Colombia	Upper middle-income	Pakistan	Lower middle-income
Cote d'Ivoire	Lower middle-income	Philippines	Lower middle-income
Democratic Republic of the Congo	Low-income	Russian Federation	Upper middle-income
Egypt	Lower middle-income	Somalia	Low-income
Ethiopia	Low-income	South Africa	Upper middle-income
Ghana	Lower middle-income	Sudan	Low-income
India	Lower middle-income	Thailand	Upper middle-income
Indonesia	Upper middle-income	Türkiye	Upper middle-income
Iran (Islamic Republic of)	Lower middle-income	Uganda	Low-income
Iraq	Upper middle-income	United Republic of Tanzania	Lower middle-income
Kenya	Lower middle-income	Viet Nam	Lower middle-income
Madagascar	Low-income	Yemen	Low-income
Malawi	Low-income	Zambia	Lower middle-income

3.2 Methods

The approach for this study is similar to the one used in a global study on adolescent health and well-being for UNFPA (Sheehan et al., 2017). It estimates both the health impact and the cost of a programme of interventions designed to reduce adolescent death and disability. The outputs from an epidemiological model are used as inputs to an economic model that estimates the economic and social benefits arising from the interventions.

The OHT model (Avenir Health, 2023) is overseen by the UN Inter-Agency Working Group on Costing, which has developed and governed the tool since the first version was launched in 2012. It estimates the costs and benefits of interventions to address many of the major causes of the adolescent burden of disease, including sexual and reproductive health (SRH), as well as a number of communicable and non-communicable diseases (NCDs). Avenir Health undertook the OHT modelling for this project.

Making an investment case for interventions that address adolescent health relies on the following:

- selecting interventions;
- identifying the target population to which the interventions will be delivered;
- specifying what proportion of the target population (population in need) will receive the intervention;
- calculating the cost associated with delivering the intervention; and
- being able to quantify the impact of the intervention on the particular aspect of adolescent health and well-being considered.

The version of OHT used in this study is Spectrum 6.3 Beta 19, which has some 390 interventions across 12 major health programmes and 70 sub-programmes.

It should be noted that the epidemiological models currently available within the tool to undertake cost and health impact modelling do not cover the full set of diseases and risk factors. Future expansions of the modelling framework are planned.

In the current version of the model, from a total of 390 there are 181 interventions for which the model also calculates health outcomes in terms of mortality, morbidity, fertility and other demographic characteristics. For the remaining interventions, the tool calculates costs only (no impact) and therefore these interventions were excluded from the modelling.

The modelling approach described below relies on comparing the benefits and costs from two different scenarios to address adolescent health over a specific period. These two scenarios (base and scale-up) were developed with an intervention period of 2023–2035.

OHT files were set up for each of the 40 countries included in the modelling. Ninety-five interventions were chosen to be included in the modelling based on their relevance to adolescents and their importance in addressing the adolescent burden of disease. These are listed in the format used by OHT in Table A1.3 below and are similar to those used in previous studies of adolescent health (Sheehan et al., 2017; Sweeny et al., 2019; Rasmussen, Sheehan et al., 2019).

Table A1.3 Interventions modelled using OHT

Maternal/newborn and reproductive health
Family planning
CPR
Safe abortion
Safe abortion
Management of abortion complications
Post-abortion case management
Ectopic case management
Pregnancy care – ANC
Tetanus toxoid (pregnant women)
Syphilis detection and treatment (pregnant women)
Basic ANC
Pregnancy care – treatment of pregnancy complications
Hypertensive disorder case management
Management of pre-eclampsia (Magnesium sulphate)
Childbirth care – facility births
Uterotonics for postpartum hemorrhage
Labor and delivery management
MgSO4 for eclampsia
Neonatal resuscitation
Management of obstructed labor
Antibiotics for maternal sepsis
Manual removal of placenta
Removal of retained products of conception
Blood transfusion
Childbirth care – home births
Clean birth environment

Table A1.3 Interventions modelled using OHT (continued)

Childbirth care – other
Antenatal corticosteroids for preterm labor
Antibiotics for preterm PROM
Induction of labor for pregnancies lasting 41+ weeks
Postpartum care – treatment of sepsis
Maternal sepsis case management
Postpartum care – treatment of newborn sepsis
Newborn sepsis – full supportive care
Newborn sepsis – injectable antibiotics
Postpartum care – other
Treatment of postpartum hemorrhage
Chlorhexidine
Child health
Zinc supplementation
Malaria
Prevention
Insecticide treated materials
Pregnant women sleeping under an ITN
Indoor residual spraying
IPT (pregnant women)
Case management
Treatment of malaria (pregnant women)
HIV/AIDS
Prevention – other
PMTCT
Care and treatment
Cotrimoxazole for children
Pediatric ART
ART (first line treatment) for men
ART (first line treatment) for women
ART (second line treatment) for adults
Nutrition
Women of reproductive age and adolescent girls
Intermittent iron-folic acid supplementation (menstruating women where anaemia is public health problem)
Pregnant and lactating women
Daily iron and folic acid supplementation (pregnant women)
Calcium supplementation for prevention and treatment of pre-eclampsia and eclampsia
Nutritional care and support for pregnant and lactating women in emergencies
NCDs
Respiratory disease
Asthma: Inhaled short acting beta agonist for intermittent asthma
Asthma: Low dose inhaled beclometasone + Short-Acting Beta-Agonists
Asthma: High dose inhaled beclometasone + Short-Acting Beta-Agonists
Asthma: Theophylline + High dose inhaled beclometasone + Short-Acting Beta-Agonists
Asthma: Oral Prednisolone + Theophylline + High dose inhaled beclometasone + Short-Acting Beta-Agonists

Table A1.3 Interventions modelled using OHT (continued)

Risk factors
Offer to help quit tobacco use: brief intervention
Screening and brief intervention for hazardous and harmful alcohol use
Physical inactivity: brief advice as part of routine care
Tobacco: Monitor tobacco use/prevention policies
Tobacco: Protect people from tobacco smoke
Tobacco: Offer to help quit tobacco use: mCessation
Tobacco: Warn about danger: Warning labels
Tobacco: Warn about danger: Mass media campaign
Tobacco: Enforce bans on tobacco advertising
Tobacco: Enforce youth access restriction
Tobacco: Raise taxes on tobacco
Tobacco: Plain packaging of tobacco products
Hazardous alcohol use: Enforce restrictions on availability of retailed alcohol
Hazardous alcohol use: Enforce restrictions on alcohol advertising
Hazardous alcohol use: Enforce drunk driving laws (sobriety checkpoints)
Hazardous alcohol use: Raise taxes on alcoholic beverages
Physical inactivity: Awareness campaigns to encourage increased physical activity
Sodium: Surveillance
Sodium: Harness industry for reformulation
Sodium: Adopt standards: Front of pack labelling
Sodium: Adopt standards: Strategies to combat misleading marketing
Sodium: Knowledge: Education and communication
Sodium: Environment: Salt reduction strategies in community-based eating spaces
Reducing obesity: Complete elimination of industrial trans fats
Reducing obesity: Replace saturated fats with unsaturated fats through reformulation, labelling, and fiscal policy
Reducing obesity: Reduce sugar consumption through taxation on sugar-sweetened beverages
Mental, neurological, and substance use disorders
Anxiety disorders
Basic psychosocial treatment for anxiety disorders (mild cases)
Basic psychosocial treatment and anti-depressant medication for anxiety disorders (moderate-severe cases)
Intensive psychosocial treatment and anti-depressant medication for anxiety disorders (moderate-severe cases)
Depression
Basic psychosocial treatment for mild depression
Basic psychosocial treatment and anti-depressant medication of first episode moderate-severe cases
Intensive psychosocial treatment and anti-depressant medication of first episode moderate-severe cases
Intensive psychosocial treatment and anti-depressant medication of recurrent moderate-severe cases on an episodic basis
Intensive psychosocial treatment and anti-depressant medication of recurrent moderate-severe cases on a maintenance basis
Psychosocial care for peri-natal depression
Psychosis
Basic psychosocial support and anti-psychotic medication
Intensive psychosocial support and anti-psychotic medication

Table A1.3 Interventions modelled using OHT (continued)

Bipolar disorder
Basic psychosocial treatment, advice, and follow-up for bipolar disorder, plus mood-stabilizing medication
Intensive psychosocial intervention for bipolar disorder, plus mood-stabilizing medication
Epilepsy
Basic psychosocial support, advice, and follow-up, plus anti-epileptic medication
Conduct disorders
Family psychoeducation (ADHD)
Family psychoeducation (conduct disorder)
Attention disorders
Methylphenidate medication
Alcohol use/dependence
Identification and assessment of new cases of alcohol use/dependence
Brief interventions and follow-up for alcohol use/dependence
Management of alcohol withdrawal
Relapse prevention medication for alcohol use/dependence

For each set of interventions chosen in OHT, the target population was also specified (for example, adolescents aged 10 to 19 years). The population in need of treatment was determined as a percentage of the target population, and then the baseline and target treatment coverage rates for this population were specified. The cost and impact of interventions are therefore modelled as a result of changing treatment coverage rates.

For the base scenario, the baseline coverage rates were kept constant over the period to 2035. For the scale-up scenario, target coverage rates in 2035 were set at 1.25 times the rate in 2023, except for some NCD interventions for which the target rates in 2035 were set using global targets. A linear scale up from 2023 to 2035 was modelled.

3.3 Cost

For the health model, the approach to estimating the costs associated with the two scenarios is similar to that for the reproductive, maternal, newborn and child health (RMNCH) set out in Stenberg et al. (2014) and used for the UNFPA global adolescent health study (Sheehan et al., 2017; Sweeny et al., 2019). The OHT includes default assumptions for unit cost of the resource inputs needed to provide each health service, including drugs and supplies, service delivery inputs and health workforce time. The results from the OHT modelling were aggregated to provide estimates by country and year of the costs of drugs and supplies, the number of inpatient days, the number of outpatient visits and the amount of personnel time in minutes per health intervention and per service delivery platform.

The cost of inpatient days was calculated by multiplying the number of days by the WHO CHOICE estimates of the average cost per bed day for each country (WHO, 2011) expressed in US dollars at 2023 values (Table A1.4). Similarly, the cost of outpatient visits was estimated by multiplying the estimated number of outpatient visits by the WHO CHOICE estimates of the average cost per outpatient visit for each country (Table A1.4). These service delivery costs from the WHO database are estimated by country and differentiated by service delivery platform. The cost of personnel time was calculated by multiplying the personnel time in years for each country by WHO CHOICE estimates of the average country-specific annual salaries for physicians, nurses and other health workers expressed in US dollars at 2023 values (Serje et al., 2018) (Table A1.5).

Table A1.4 Unit cost of outpatient visits and inpatient days, average of delivery platforms, US dollars 2023

Country	Outpatient visit	Inpatient day
Afghanistan	0.8	2.3
Angola	9.4	58.5
Bangladesh	1.7	6.9
Brazil	4.5	33.8
Burkina Faso	1.8	7.0
Côte d'Ivoire	2.8	12.2
Cameroon	3.1	13.9
China	9.6	65.1
Colombia	26.4	103.5
Democratic Republic of the Congo	37.4	95.7
Egypt	7.2	46.1
Ethiopia	1.0	3.5
Ghana	2.4	9.9
India	3.2	16.8
Indonesia	4.6	26.1
Iran (Islamic Republic of)	13.4	114.8
Iraq	4.0	21.9
Kenya	2.1	8.6
Madagascar	1.0	3.4
Malawi	1.5	5.1
Mali	1.7	6.4
Mexico	22.8	198.9
Mozambique	1.4	4.8
Myanmar	1.9	7.3
Nepal	1.4	5.4
Niger	1.0	3.0
Nigeria	3.4	15.7
Pakistan	2.0	9.6
Philippines	4.4	24.5
Russian Federation	24.6	232.9
Somalia	1.0	3.5
South Africa	16.4	123.7
Sudan	3.4	16.3
Thailand	8.8	63.2
Türkiye	23.8	207.4
Uganda	1.6	6.0
United Republic of Tanzania	1.6	6.3
Viet Nam	2.8	14.4
Yemen	4.0	19.0
Zambia	2.2	9.1

Source: WHO (2011).

Table A1.5 Health worker unit costs

World bank income categories	Health worker cadre	Average earnings index (multiple of GDP per capita)
Upper middle income	Physicians	2.7
Upper middle income	Nurses and midwives	2.2
Upper middle income	Other health workers	1.3
Lower middle income	Physicians	5.1
Lower middle income	Nurses and midwives	4.2
Lower middle income	Other health workers	2.4
Low income	Physicians	7.8
Low income	Nurses and midwives	6.4
Low income	Other health workers	3.7

Source: Serje et al. (2018).

The other components of cost: supply chain, infrastructure and equipment, governance, health information systems, health financing, emergency and reconstruction and additional programmes, were calculated as a markup of the combined direct costs of drugs and supplies, inpatient days, outpatient visits and personnel time. Results from a study that looked at the investment needed to advance the UHC agenda in 67 countries for the period 2016 to 2030 (Stenberg et al., 2017, Tables S16–S17) indicated that the total investment cost is, on average, 2.2 to 2.5 times the combined direct costs. As some of the costs included within their estimates are not likely to be applicable for the adolescent investment case, we estimate total costs as two times the combined direct costs.

All costs were expressed in US dollars at 2023 prices and, where necessary, prices were adjusted from their base year to 2023 using the United States of America GDP implicit price deflator (US BEA, 2023) (Table A1.6).

3.4 Health outcomes

The reproductive, sexual and other health outcomes from modelling interventions with the OHT are usually expressed as the number of deaths and amount of morbidity that occurs for each health condition each year for each age group and sex (where this is available). For some areas within the OHT, it is possible to obtain health outcome data by age and sex, in which case the impact on adolescents could be assessed directly. In other areas, this data is for the whole of the population being targeted, in which case the adolescent proportion was calculated according to that used for allocating costs based on population proportions.

Table A1.6 United States of America GDP Deflator

2010	91.9
2011	93.8
2012	95.5
2013	97.2
2014	99.0
2015	100.0
2016	101.0
2017	102.9
2018	105.4
2019	107.3
2020	108.7
2021	113.6
2022	121.5
2023 estimated	127.6

Source: U.S. Bureau of Economic Analysis (2023).

In addition, estimates were made of the numbers of mothers and newborns with serious disabilities, as well as the number of adolescents with serious disabilities arising from each of the NCDs being modelled. Based on the analysis by Stenberg et al. (2014), it was assumed that, for adolescent mothers, the number with a serious disability from obstructed labour was six times that of the number of deaths, with half of these being unable to work and half able to work at 50% of the productivity of a healthy adolescent.

Similarly, the number of adolescents with a serious disability from other maternal disorders was estimated to be twice the number of deaths from this cause, divided equally between those unable to work and those able to work at 50% productivity. A similar approach was used to estimate serious disability associated with the causes of newborn deaths. Serious disability from prematurity was assumed to be 1.65 times the number of deaths, from asphyxia 0.9 times and from congenital abnormalities equal to the number of deaths.

3.5 Economic and social benefits

To estimate the ROI for health intervention programmes, it is necessary to express the improved health outcomes in economic terms and compare these with the costs of the programmes. As noted above, the approach builds on previous studies (Sheehan et al., 2017; Sweeny et al., 2019) focused on economic and social benefits and is described below.

Economic benefits

Comparing an intervention scale-up scenario with a base scenario enables the calculation of the number of deaths and amount of morbidity averted to be compared to the additional cost. Within our model, we consider that the economic benefits of interventions preventing deaths occur when people who would otherwise die prematurely enter the workforce and produce economic output. A similar benefit occurs for people who would otherwise suffer a serious disability that prevents them from working.

In this study, the economic modelling of mortality follows the cohort of deaths averted for each of the years from 2023 to 2035. Each cohort is classified by age and sex. As the cohort ages, it is subject to the mortality rates applicable to that age group, sex and year based on estimates from the UN World Population Prospects data (UN, 2022) for each of the 40 countries. The effect of avoided mortality on the labour force is calculated by taking the numbers of deaths avoided by age and gender and applying a corresponding labour force participation rate for this age, gender and year sourced from the International Labor Organization (ILO) projections of labour force participation rates (ILO, 2021) in each of the 40 countries.

The contribution that each of these labour force cohorts makes to economic output is calculated by multiplying the number in each age and sex category by a productivity level that varies with age and year. To do this, the average productivity is first calculated by dividing the World Bank estimate of GDP in current US dollars by the labour force for the most recent year for which data are available (2021) (World Bank, 2023b). This average productivity then increases at an annual rate determined by the country's income status.

Based on an analysis of trends in World Bank data for real GDP and labor force since 1990, the modelling assumes that annual productivity growth for LICs, LMICs, UMICs and HICs is 2.1%, 2.5%, 1.6% and 0.7%, respectively. Further, it is assumed that the country's income status changes after 15 years. For LMICs and UMICs, this results in slower productivity growth after 15 years.

Productivity varies by age so, as a proxy for this, the distribution of hourly wage rates by age for Australia for 2021 (ABS, 2022) is used. Average productivity for each age group is calculated by multiplying average productivity by the ratio of hourly wage rates for the age group to overall hourly wage rates. The total GDP generated is calculated by summing the GDP produced by each cohort for each year of the period in which they are in the labour force. The contribution to GDP of each cohort of persons who would otherwise suffer from serious disabilities is calculated in a similar way as for mortality, using the same assumptions about participation rates and productivity.

Social benefits

Health has an intrinsic value and, in addition to the market value put on health improvements (here captured by labour productivity), many studies apply a value of a statistical life (VSL) approach. This allows researchers to fully capture the value of the social benefit of health improvement. Following past approaches, we consider social benefits as a subset of the VSL year. Building on the results of Viscusi and Aldy (2003), Jamison et al. (2013) estimated the value of a life year as between 1.4 and 4.2 times GDP per capita, averaging 1.6 globally.

Stenberg et al. (2014) applied an approach in which benefits not captured in labour productivity measures were referred to as "social benefits." The social benefits were estimated within a VSL envelope that was, on average, assuming the value of a life year as 1.5 times GDP per capita. As the calculated economic benefit in

the Stenberg et al. (2014) study represented roughly one times GDP per capita, this left a residual value of 0.5 times GDP per capita as the estimated social benefit. Following the same approach, a value of 0.5 GDP per capita is assigned to each healthy life year gained (HLYG) from the interventions to estimate the social benefit of improved health.

3.6 ROI in adolescent health

The rate of ROI can be expressed in a number of different but related ways. In this study, we report BCRs as they are intuitively easier to understand. The BCR divides the estimate of benefits by the estimate of costs. A BCR greater than one means that the benefits of an intervention programme are greater than the costs of the programme.

It is standard practice when calculating BCRs to express these benefits and costs in NPV terms. Given benefits and costs for years in the future are usually regarded as having a lower value than those in the present, a discount rate is applied to these future benefits and costs. Most analyses of long-term projects adopt the standard World Bank discount rate of 3% to calculate NPVs (Weitzman, 2001; United States Office of Management and Budget, 2003; Arrow et al., 2013; Campos et al., 2013). This rate is adopted here.

Tables related to Chapter 1

Table A1.7 Country/territory coverage of analyses

Countries and territories	Income status	OHT analysis	HPV	TB	Myopia	Education	Child marriage	Road safety	Stelmach et al. 2022	Verguet et al. 2020
		Total number of countries								
		40	78	50	19	64	70	77	36	14
Afghanistan	Low-income	*	*	*	*		*	*	*	
Albania	Upper middle-income									
Algeria	Lower middle-income								*	
Angola	Lower middle-income	*	*	*				*		
Argentina	Upper middle-income								*	
Armenia	Upper middle-income						*			
Azerbaijan	Upper middle-income						*	*		
Bangladesh	Lower middle-income	*	*	*	*	*	*	*	*	
Benin	Lower middle-income		*	*		*	*	*		
Bhutan	Lower middle-income		*							
Bolivia (Plurinational State of)	Lower middle-income		*	*		*	*	*		
Botswana	Upper middle-income					*		*		*
Brazil	Upper middle-income	*					*	*	*	*
Burkina Faso	Low-income	*	*	*		*	*	*		
Burundi	Low-income		*	*	*	*	*	*		

Table A1.7 Country/territory coverage of analyses (continued)

Countries and territories	Income status	OHT analysis	HPV	TB	Myopia	Education	Child marriage	Road safety	Stelmach et al. 2022	Verguet et al. 2020
		Total number of countries								
		40	78	50	19	64	70	77	36	14
Cabo Verde	Lower middle-income		*							*
Cambodia	Lower middle-income		*	*	*	*	*	*		
Cameroon	Lower middle-income	*	*	*		*	*	*		
Central African Republic	Low-income		*	*		*	*	*		
Chad	Low-income		*	*		*	*	*		
Chile	High income							*		*
China	Upper middle-income	*			*	*		*	*	
Colombia	Upper middle-income	*				*		*	*	
Comoros	Lower middle-income		*			*	*	*		
Congo	Lower middle-income		*	*		*	*	*		
Côte d'Ivoire	Lower middle-income	*	*	*		*	*	*		*
Democratic People's Republic of Korea	Low-income		*	*				*		
Democratic Republic of the Congo	Low-income	*	*	*		*	*	*	*	
Djibouti	Lower middle-income		*			*	*	*		
Ecuador	Upper middle-income									*
Egypt	Lower middle-income	*	*			*	*	*	*	
El Salvador	Upper middle-income		*							
Equatorial Guinea	Upper middle-income						*	*		
Eritrea	Low-income		*	*	*		*	*		
Eswatini	Lower middle-income		*					*		
Ethiopia	Low-income	*	*	*	*	*	*	*	*	
France	High income								*	
Gabon	Upper middle-income					*	*	*		
Gambia	Low-income		*			*	*	*		
Georgia	Upper middle-income		*							
Germany	High income								*	

Table A1.7 Country/territory coverage of analyses (continued)

Countries and territories	Income status	OHT analysis	HPV	TB	Myopia	Education	Child marriage	Road safety	Stelmach et al. 2022	Verguet et al. 2020
		Total number of countries								
		40	78	50	19	64	70	77	36	14
Ghana	Lower middle-income	*	*	*		*	*	*		*
Guatemala	Upper middle-income					*	*	*		
Guinea	Lower middle-income		*	*		*	*	*		
Guinea-Bissau	Low-income		*				*	*		
Guyana	High income					*				
Haiti	Lower middle-income		*	*		*	*	*		
Honduras	Lower middle-income		*							
India	Lower middle-income	*	*	*		*	*	*	*	*
Indonesia	Upper middle-income	*	*	*	*	*	*	*	*	
Iran (Islamic Republic of)	Lower middle-income	*							*	
Iraq	Upper middle-income	*					*	*	*	
Italy	High income								*	
Japan	High income								*	
Kenya	Lower middle-income	*	*	*	*	*	*	*	*	*
Kyrgyzstan	Lower middle-income		*			*	*	*		
Lao People's Democratic Republic	Lower middle-income		*	*	*	*	*	*		
Lesotho	Lower middle-income		*	*		*	*	*		
Liberia	Low-income		*	*		*	*	*		
Madagascar	Low-income	*	*	*		*	*	*		
Malawi	Low-income	*	*	*		*	*	*		
Mali	Low-income	*	*	*		*	*	*		*
Mauritania	Lower middle-income		*			*	*	*		
Mexico	Upper middle-income	*				*	*	*	*	*
Mongolia	Lower middle-income		*							
Morocco	Lower middle-income		*			*	*	*	*	
Mozambique	Low-income	*	*	*		*	*	*	*	
Myanmar	Lower middle-income	*	*	*	*	*	*	*		
Namibia	Upper middle-income			*		*				*

Table A1.7 Country/territory coverage of analyses (continued)

Countries and territories	Income status	OHT analysis	HPV	TB	Myopia	Education	Child marriage	Road safety	Stelmach et al. 2022	Verguet et al. 2020
		Total number of countries								
		40	78	50	19	64	70	77	36	14
Nepal	Lower middle-income	*	*	*	*	*	*	*		
Nicaragua	Lower middle-income		*							
Niger	Low-income	*	*	*		*	*	*		
Nigeria	Lower middle-income	*	*	*		*	*	*	*	*
occupied Palestinian territory, including east Jerusalem	Upper middle-income		*		*					
Pakistan	Lower middle-income	*	*	*	*	*	*	*	*	
Papua New Guinea	Lower middle-income		*	*	*		*	*		
Peru	Upper middle-income			*		*	*	*		
Philippines	Lower middle-income	*	*	*	*	*	*	*	*	
Republic of Moldova	Upper middle-income		*							
Russian Federation	Upper middle-income	*							*	
Rwanda	Low-income		*	*	*	*	*	*		
São Tomé and Príncipe	Lower middle-income		*			*	*	*		
Senegal	Lower middle-income		*	*		*	*	*		
Sierra Leone	Upper middle-income		*	*		*	*	*		
Solomon Islands	Lower middle-income		*				*	*		
Somalia	Low-income	*	*	*		*	*	*		
South Africa	Upper middle-income	*		*		*	*	*	*	*
South Sudan	Low-income		*	*				*		
Sri Lanka	Lower middle-income		*							
Sudan	Low-income	*	*			*	*	*	*	
Syrian Arab Republic	Low-income		*			*				
Tajikistan	Lower middle-income		*			*	*	*		
Thailand	Upper middle-income	*							*	
Timor-Leste	Lower middle-income		*		*					
Togo	Low-income		*	*		*	*	*		

Table A1.7 Country/territory coverage of analyses (continued)

Countries and territories	Income status	OHT analysis	HPV	TB	Myopia	Education	Child marriage	Road safety	Stelmach et al. 2022	Verguet et al. 2020
		Total number of countries								
		40	78	50	19	64	70	77	36	14
Tunisia	Lower middle-income		*							
Türkiye	Upper middle-income	*							*	
Turkmenistan	Upper middle-income						*	*		
Uganda	Low-income	*	*	*		*	*	*	*	
Ukraine	Lower middle-income		*							
United Kingdom of Great Britain and Northern Ireland	High income								*	
United Republic of Tanzania	Lower middle-income	*	*	*		*	*	*	*	
United States of America	High income								*	
Uzbekistan	Lower middle-income		*			*	*	*		
Vanuatu	Lower middle-income		*							
Viet Nam	Lower middle-income	*	*		*		*	*	*	
Yemen	Low-income	*	*			*	*	*	*	
Zambia	Lower middle-income	*	*	*		*	*	*		
Zimbabwe	Lower middle-income		*	*		*	*	*		

Sources: This report: Stelmach et al. (2022); Verguet et al. (2020). For list of countries, see World Bank at https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups

Annex 1: References

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Annex 2. Chapter 2 tables

Table A2.1 Countries included in OHT modelling, income status

Afghanistan	Low-income
Angola	Lower middle-income
Bangladesh	Lower middle-income
Brazil	Upper middle-income
Burkina Faso	Low-income
Cameroon	Lower middle-income
China	Upper middle-income
Colombia	Upper middle-income
Côte d'Ivoire	Lower middle-income
Democratic Republic of the Congo	Low-income
Egypt	Lower middle-income
Ethiopia	Low-income
Ghana	Lower middle-income
India	Lower middle-income
Indonesia	Upper middle-income
Iran, Islamic Republic of	Lower middle-income
Iraq	Upper middle-income
Kenya	Lower middle-income
Madagascar	Low-income
Malawi	Low-income
Mali	Low-income
Mexico	Upper middle-income
Mozambique	Low-income
Myanmar	Lower middle-income
Nepal	Lower middle-income
Niger	Low-income
Nigeria	Lower middle-income
Pakistan	Lower middle-income
Philippines	Lower middle-income
Russian Federation	Upper middle-income
Somalia	Low-income
South Africa	Upper middle-income
Sudan	Low-income
Thailand	Upper middle-income
Türkiye	Upper middle-income
Uganda	Low-income
United Republic of Tanzania	Lower middle-income
Viet Nam	Lower middle-income
Yemen	Low-income
Zambia	Lower middle-income

Table A2.2 Interventions modelled using OHT

Maternal/newborn and reproductive health
Family planning
CPR
Safe abortion
Safe abortion
Management of abortion complications
Post-abortion case management
Ectopic case management
Pregnancy care – ANC
Tetanus toxoid (pregnant women)
Syphilis detection and treatment (pregnant women)
Basic ANC
Pregnancy care – treatment of pregnancy complications
Hypertensive disorder case management
Management of pre-eclampsia (Magnesium sulphate)
Childbirth care – facility births
Uterotonics for postpartum hemorrhage
Labor and delivery management
MgSO4 for eclampsia
Neonatal resuscitation
Management of obstructed labor
Antibiotics for maternal sepsis
Manual removal of placenta
Removal of retained products of conception
Blood transfusion
Childbirth care – home births
Clean birth environment
Childbirth care – other
Antenatal corticosteroids for preterm labor
Antibiotics for preterm PROM
Induction of labor for pregnancies lasting 41+ weeks
Postpartum care – treatment of sepsis
Maternal sepsis case management
Postpartum care – treatment of newborn sepsis
Newborn sepsis – full supportive care
Newborn sepsis – injectable antibiotics
Postpartum care – other
Treatment of postpartum hemorrhage
Chlorhexidine
Child health
Zinc supplementation

Table A2.2 Interventions modelled using OHT (continued)

Malaria

Prevention

Insecticide treated materials

Pregnant women sleeping under an ITN

Indoor residual spraying

IPT (pregnant women)

Case management

Treatment of malaria (pregnant women)

HIV/AIDS

Prevention – other

PMTCT

Care and treatment

Cotrimoxazole for children

Pediatric ART

ART (first line treatment) for men

ART (first line treatment) for women

ART (second line treatment) for adults

Nutrition

Women of reproductive age and adolescent girls

Intermittent iron-folic acid supplementation (menstruating women where anaemia is public health problem)

Pregnant and lactating women

Daily iron and folic acid supplementation (pregnant women)

Calcium supplementation for prevention and treatment of pre-eclampsia and eclampsia

Nutritional care and support for pregnant and lactating women in emergencies

NCDs

Respiratory disease

Asthma: Inhaled short acting beta agonist for intermittent asthma

Asthma: Low dose inhaled beclometasone + Short-Acting Beta-Agonists

Asthma: High dose inhaled beclometasone + Short-Acting Beta-Agonists

Asthma: Theophylline + High dose inhaled beclometasone + Short-Acting Beta-Agonists

Asthma: Oral Prednisolone + Theophylline + High dose inhaled beclometasone + Short-Acting Beta-Agonists

Risk factors

Offer to help quit tobacco use: brief intervention

Screening and brief intervention for hazardous and harmful alcohol use

Physical inactivity: brief advice as part of routine care

Tobacco: Monitor tobacco use/prevention policies

Tobacco: Protect people from tobacco smoke

Tobacco: Offer to help quit tobacco use: mCessation

Tobacco: Warn about danger: Warning labels

Tobacco: Warn about danger: Mass media campaign

Tobacco: Enforce bans on tobacco advertising

Tobacco: Enforce youth access restriction

Tobacco: Raise taxes on tobacco

Tobacco: Plain packaging of tobacco products

Hazardous alcohol use: Enforce restrictions on availability of retailed alcohol

Hazardous alcohol use: Enforce restrictions on alcohol advertising

Table A2.2 Interventions modelled using OHT (continued)

Hazardous alcohol use: Enforce drunk driving laws (sobriety checkpoints)

Hazardous alcohol use: Raise taxes on alcoholic beverages

Physical inactivity: Awareness campaigns to encourage increased physical activity

Sodium: Surveillance

Sodium: Harness industry for reformulation

Sodium: Adopt standards: Front of pack labelling

Sodium: Adopt standards: Strategies to combat misleading marketing

Sodium: Knowledge: Education and communication

Sodium: Environment: Salt reduction strategies in community-based eating spaces

Reducing obesity: Complete elimination of industrial trans fats

Reducing obesity: Replace saturated fats with unsaturated fats through reformulation, labelling, and fiscal policy

Reducing obesity: Reduce sugar consumption through taxation on sugar-sweetened beverages

Mental, neurological, and substance use disorders

Anxiety disorders

Basic psychosocial treatment for anxiety disorders (mild cases)

Basic psychosocial treatment and anti-depressant medication for anxiety disorders (moderate-severe cases)

Intensive psychosocial treatment and anti-depressant medication for anxiety disorders (moderate-severe cases)

Depression

Basic psychosocial treatment for mild depression

Basic psychosocial treatment and anti-depressant medication of first episode moderate-severe cases

Intensive psychosocial treatment and anti-depressant medication of first episode moderate-severe cases

Intensive psychosocial treatment and anti-depressant medication of recurrent moderate-severe cases on an episodic basis

Intensive psychosocial treatment and anti-depressant medication of recurrent moderate-severe cases on a maintenance basis

Psychosocial care for peri-natal depression

Psychosis

Basic psychosocial support and anti-psychotic medication

Intensive psychosocial support and anti-psychotic medication

Bipolar disorder

Basic psychosocial treatment, advice, and follow-up for bipolar disorder, plus mood-stabilizing medication

Intensive psychosocial intervention for bipolar disorder, plus mood-stabilizing medication

Epilepsy

Basic psychosocial support, advice, and follow-up, plus anti-epileptic medication

Conduct disorders

Family psychoeducation (ADHD)

Family psychoeducation (conduct disorder)

Attention disorders

Methylphenidate medication

Alcohol use/dependence

Identification and assessment of new cases of alcohol use/dependence

Brief interventions and follow-up for alcohol use/dependence

Management of alcohol withdrawal

Relapse prevention medication for alcohol use/dependence

Table A2.3 Fertility rates, females 15–19, 2023–2035

Income Status	2023	Scale-up	% reduction
Low-income countries	115.6	89.8	22.3
Lower middle-income countries	74.8	58.2	22.9
Upper middle-income countries	39.2	26.9	31.4
All countries modelled	**79.1**	**60.6**	**23.4**

Table A2.4 Reduction in births to adolescent mothers, 2023–2035

Income Status	Number
Low-income countries	6 095 792
Lower middle-income countries	11 578 598
Upper middle-income countries	4 254 626
All countries modelled	**1 929 016**

Table A2.5 Maternal, neonatal, child deaths and stillbirths averted by OHT interventions, 2023–2035

Income Status	Maternal	Stillbirths	Neonatal	Child deaths
Low-income countries	55 655	254 646	342 520	338 180
Lower middle-income countries	49 909	399 604	650 861	453 779
Upper middle-income countries	39 276	41 545	54 826	33 915
All countries modelled	**144 840**	**695 835**	**1 048 207**	**825 874**

Table A2.6 Adolescent deaths from NCDs averted by OHT interventions, 2023–2035

Income Status	Alcohol	Bipolar	Depression	Epilepsy
Low-income countries	1 325	31 079	2 269	534
Lower middle-income countries	5 040	91 884	5 721	1 428
Upper middle-income countries	3 134	45 173	2 022	649
All countries modelled	**9 551**	**169 283**	**10 097**	**2 632**

Table A2.7 Reduction in anemia through OHT interventions, adolescents, 2023–2035

Income Status	Pregnant women with anemia	Pregnant women with iron-deficiency anemia	Women of reproductive age with anemia	Women of reproductive age with iron-deficiency anemia
Low-income countries	5 288 106	2 474 322	5 177 102	2 493 172
Lower middle-income countries	14 188 710	6 424 816	15 961 552	7 291 592
Upper middle-income countries	1 754 669	1 029 880	1 619 501	976 163
All countries modelled	**21 231 485**	**9 929 018**	**22 758 155**	**10 760 927**

Table A2.8 Reduction in number of stunted children through OHT interventions, 2023–2035

Income Status	Number
Low-income countries	9 854 921
Lower middle-income countries	13 083 147
Upper middle-income countries	3 588 691
All countries modelled	**26 526 759**

Table A2.9 Reduction in prevalence of mental disorders and other NCDs through OHT interventions, female adolescents, 2023–2035

Income Status	Alcohol use/ dependence	Anxiety disorders	Asthma	Attention disorders	Conduct disorders	Depression	Epilepsy
Low-income countries	25 418	317 529	66 222	7 122	14 489	592 837	103 314
Lower middle-income countries	115 211	1 017 478	131 848	14 351	29 903	1 575 898	290 474
Upper middle-income countries	63 640	660 610	133 029	13 495	26 886	877 464	129 046
All countries modelled	**205 214**	**2 007 641**	**334 336**	**35 330**	**72 006**	**3 067 243**	**526 765**

Table A2.10 Reduction in prevalence of mental disorders and other NCDs through OHT interventions, male adolescents, 2023–2035

Income Status	Alcohol use/ dependence	Anxiety disorders	Asthma	Attention disorders	Conduct disorders	Depression	Epilepsy
Low-income countries	56 407	245 967	77 444	17 001	39 377	490 330	121 553
Lower middle-income countries	306 198	847 601	256 178	37 731	89 017	1 167 569	341 161
Upper middle-income countries	287 748	527 253	186 292	41 178	86 263	633 419	164 730
All countries modelled	**652 195**	**1 629 340**	**523 295**	**96 836**	**216 609**	**2 309 561**	**632 039**

Table A2.11 Adolescent health, economic and social benefits, and costs ($ million), and BCRs

Income Status	Economic benefit	Social benefit	Cost	BCR economic	BCR economic and social	BCR economic	BCR economic and social
				Unweighted average		Weighted average	
Low-income countries	16 975	8 076	5857	7.5	11.1	2.9	4.3
Lower middle-income countries	73 061	39 633	11 598	7.7	11.8	6.3	9.7
Upper middle-income countries	22 596	13 255	14 751	2.2	3.5	1.5	2.4
All countries modelled	**112 632**	**60 964**	**32 206**	**6.3**	**9.6**	**3.5**	**5.4**

Table A2.12 Return on investment from scale-up of HPV vaccination, screening and treatment, economic and social benefits, and costs ($ million), and BCRs

Income Status	Deaths averted	Economic benefit	Social benefit	Cost	BCR economic	BCR economic plus social	BCR economic	BCR economic plus social
					Unweighted average		Weighted average	
Low-income countries	2 575 618	12 344	6 297	1 616	10.5	16.0	7.6	11.5
Lower middle-income countries	5 136 439	47 278	31 185	4 036	14.6	23.4	11.7	19.4
Upper middle-income countries	411 823	6 217	5 019	427	6.2	11.5	14.6	26.3
All countries	**8 123 880**	**65 839**	**42 500**	**6 079**	**12.7**	**20.2**	**10.8**	**17.8**

Table A2.13 Upper middle-income countries and areas eligible for TB funding from the Global Fund

Armenia	Guatemala	Republic of Moldova
Azerbaijan	Guyana	Saint Lucia
Belarus	Iraq	Saint Vincent and the Grenadines
Botswana	Jordan	South Africa
Colombia	Kazakhstan	Suriname
Dominica	Libya	Thailand
Dominican Republic	Malaysia	Tonga
Equatorial Guinea	Maldives	Turkmenistan
Fiji	Marshall Islands	Tuvalu
Gabon	Namibia	Venezuela (Bolivarian Republic of)
Georgia	Peru	Kosovo[1]
Grenada	Romania	

Source: The Global Fund (2023).

Table A2.14 TB, number of adolescent deaths per 100 000 population

Income status	2023	2024	2025	2026	2027	2028	2029	2030	2023–2030
Total (Global)	**15.4**	**14.5**	**12.3**	**8.5**	**5.7**	**3.9**	**2.7**	**1.9**	**8**
By income status									
Low-income countries	24.8	22.2	17.7	11.4	7.9	5.9	4.5	3.4	11.3
Lower middle-income countries	27.1	25.7	21.9	15.3	10.2	6.9	4.7	3.2	14.3
Upper middle-income countries	5.3	5	4.2	2.8	1.9	1.3	0.9	0.6	2.7
High-income countries	0.9	0.8	0.7	0.5	0.3	0.2	0.1	0.1	0.5
GFATM-eligible countries by income status									
Low-income countries	24.8	22.2	17.7	11.4	7.9	5.9	4.5	3.4	11.3
Lower middle-income countries	27.1	25.7	21.9	15.3	10.2	6.9	4.7	3.2	14.3
Upper middle-income countries	26.1	25.1	21.5	14.7	9.5	6.2	4	2.7	14
All GFATM-eligible countries	26.6	25	21.1	14.5	9.7	6.6	4.6	3.2	13.7

Note: GFATM is Global Fund to Fight AIDS Tuberculosis and Malaria. Source: Stop TB partnership (2022 Table A1.1).

Table A2.15 Global world population 2023 to 2023 thousands

Income status	2023	2024	2025	2026	2027	2028	2029	2030
Low-income countries	757 744	778 348	799 236	820 337	841 644	863 157	884 865	906 731
Lower middle-income countries	3 470 786	3 515 739	3 560 078	3 603 567	3 646 328	3 688 596	3 730 434	3 771 900
Upper middle-income countries	2 531 960	2 537 542	2 542 889	2 547 887	2 552 517	2 556 710	2 560 461	2 563 782
High-income countries	1 255 306	1 257 124	1 259 160	1 261 444	1 263 896	1 266 346	1 268 711	1 270 948
Total	**8 015 796**	**8 088 753**	**8 161 363**	**8 233 235**	**8 304 385**	**8 374 808**	**8 444 471**	**8 513 361**
Eligible upper middle-income countries	714 718	721 020	727 479	733 943	740 314	746 574	752 708	758 706

Source: UN (2022).

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1. *All references to Kosovo in this document should be understood to be in the context of the United Nations Security Council resolution 1244 (1999).*

Table A2.16 TB, number of adolescent deaths averted 2023 to 2023

Income status	2023	2024	2025	2026	2027	2028	2029	2030	2023–2030
Low-income countries	1 879 206	1 727 932	1 414 648	935 184	664 899	509 263	398 189	308 289	7 837 610
Lower middle-income countries	9 405 829	9 035 450	7 796 570	5 513 458	3 719 255	2 545 131	1 753 304	1 207 008	40 976 005
Upper middle-income countries	1 341 939	1 268 771	1 068 013	713 408	484 978	332 372	230 441	153 827	5 593 750
High-income countries	112 978	100 570	88 141	63 072	37 917	25 327	12 687	12 709	453 401
Total	**12 739 952**	**12 132 723**	**10 367 373**	**7 225 122**	**4 907 048**	**3 412 093**	**2 394 622**	**1 681 833**	**54 860 766**
Eligible upper middle-income countries	1 865 413	1 809 761	1 564 079	1 078 896	703 299	462 876	301 083	204 851	1 070 384

Source: Estimates from modeling.

Table A2.17 TB in adolescents, cost estimates billions 2020 dollars

Income status	2023	2024	2025	2026	2027	2028	2029	2030	2023–2030
Total (Global)	**15.7**	**17.6**	**20.3**	**21.9**	**33.1**	**32.8**	**33.6**	**34.9**	**209.8**
By income status									
Low-income countries	1.8	2.1	2.3	2.5	3.5	3.6	3.7	3.9	23.4
Lower middle-income countries	8.5	9.7	11.4	12.5	16.7	16.4	16.7	17.3	109.1
Upper middle-income countries	4.9	5.3	6	6.4	10.4	10.4	10.7	11.1	65.2
High-income countries	0.4	0.5	0.5	0.5	2.4	2.4	2.6	2.7	12.1
GFATM-eligible countries by income status									
Low-income countries	1.8	2.1	2.3	2.5	3.5	3.6	3.7	3.9	23.4
Lower middle-income countries	8.5	9.7	11.4	12.5	16.7	16.4	16.6	17.2	109
Upper middle-income countries	1.5	1.6	1.8	1.8	2.4	2.4	2.4	2.5	16.4
All GFATM-eligible countries	11.8	13.3	15.5	16.8	22.6	22.3	22.7	23.6	148.7

Source: Stop TB partnership (2022, Table A1.5).

Table A2.18 TB in adolescents cost per death averted 2023 to 2023

Income status	2023	2024	2025	2026	2027	2028	2029	2030	Average 2023 to 2030
Low-income countries	958	1 215	1 626	2 673	5 264	7 069	9 292	12 650	2 986
Lower middle-income countries	904	1 074	1 462	2 267	4 490	6 444	9 525	14 333	2 665
Upper middle-income countries	3 651	4 177	5 618	8 971	21 444	31 290	46 433	72 159	11 656
High-income countries	3 541	4 972	5 673	7 927	63 296	94 761	20 432	212 440	26 467
Eligible upper middle-income countries	804	884	1 151	1 668	3 412	5 185	7 971	12 204	4 160

Table A2.19 TB in adolescents deaths averted 2023 to 2035

Income Status	Female	Female	Male	Male	Persons
	10–14 years	**15–19 years**	**10–14 years**	**15–19 years**	**10–19 years**
Low-income countries	5 000	12 028	4 501	19 938	41 465
Lower middle-income countries	10 318	24 219	7 879	26 303	68 719
Upper middle-income countries	510	2 155	713	3 002	6 376
Total	**15 828**	**38 401**	**13 092**	**49 242**	**116 560**

Table A2.20 TB in adolescents economic and social benefits and costs ($ million) and BCRs (3% discount rate)

Income Status	Economic benefit	Social benefit	Cost	BCR economic	BCR economic and social	BCR economic	BCR economic and social
				Unweighted average		**Weighted average**	
Low-income countries	1 861	638	106	17.6	23.6	18.1	24.6
Lower middle-income countries	7 725	3 287	157	49.1	70.0	52.9	72.8
Upper middle-income countries	1 266	548	23	55.4	79.3	67.4	95.9
Total	**10 852**	**4 473**	**286**	**39.4**	**54.4**	**37.9**	**53.6**

Table A2.21 Myopia number of adolescent patients treated 2021 to 2030

Income Status	Female	Female	Male	Male	Persons	Persons
	10–14	**15–19**	**10–14**	**15–19**	**10–14**	**15–19**
Upper middle-income countries	601 961	539 226	536 949	481 835	1 138 910	1 021 060
Lower middle-income countries	472 513	437 543	420 544	388 277	893 057	825 820
Low-income countries	108 048	102 511	106 809	101 617	214 857	204 128
Total	**1 182 522**	**1 079 280**	**1 064 302**	**971 728**	**2 246 824**	**2 051 008**

Table A2.22 Myopia in adolescents benefits and costs ($ million) and BCRs (3% discount rate)

Income Status	Economic benefit	Cost	BCR	BCR
			Unweighted average	**Weighted average**
Upper middle-income countries	153 763	5 759	22.1	26.7
Lower middle-income countries	35315	2 893	14.9	12.2
Low-income countries	2 351	441	4.8	5.3
Total	**191 429**	**9 092**	**13.0**	**21.1**

Annex 2: References

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