Chapter 26

Identifying an Essential Package for Adolescent Health: Economic Analysis

Susan Horton, Elia De la Cruz Toledo, Jacqueline Mahon, John Santelli, and Jane Waldfogel

INTRODUCTION

Adolescents form a large proportion of the population in many low- and middle-income countries (LMICs)—more than 20 percent in the countries with the fastest-growing populations (WHO 2014). The adolescent period, defined as ages 10 through 19 years, is key to future health because it is during these years that health decisions and habits are formed that have long-term impacts. Adolescents who are enabled to make healthy eating and exercise choices, to adopt healthy sexual behaviors, and to avoid addictive substances and excessive risks have the best opportunities for health in later life. Equally important, some mental health issues are manifested in late adolescence, and early detection is important.

Despite the pivotal nature of this age, adolescents until recently have been relatively neglected in international donor strategies for maternal, newborn, and child health. Specific areas where funding is lacking include preventing unsafe abortion and coerced sex, and providing antenatal, childbirth, and postnatal care (iERG 2013). Many adolescents are entitled to appropriate health care under the Convention on the Rights of the Child, but those ages 18 and 19 years are not specifically included.

Recent reports and studies seek to bring greater attention to adolescent health needs (Gorna and others 2015; Laski and others 2015; Patton and others 2016; UNICEF 2011, 2012; WHO 2014). Groups such as the International Health Partnership (http://www.internationalhealthpartnership.net) have begun to modify the well-known term *RMNCH* (Reproductive, Maternal, Newborn, and Child Health) to *RMNCAH* to include adolescents. The Every Woman Every Child (2015) strategy is titled "The Global Strategy for Women's, Children's and Adolescents' Health 2016–2030" and signals a positive change. It highlights research indicating that the health of women, children, and adolescents is central to the Sustainable Development Goals for 2030. The term *youth* is mentioned 10 times in the Outcome Declaration of the Sustainable Development Agenda (UN 2015), and the term *adolescent* is mentioned once in reference to adolescent girls.

This chapter provides an overview of methods and examines the economic case for investment in adolescent health by surveying what is known on cost, cost-effectiveness, and cost-benefit ratios of interventions. We then use these economic data to examine the cost of an essential package of health and behavioral interventions that all countries need to provide. The essential package draws on packages developed elsewhere (Every Woman Every Child 2015; Patton and others 2016; WHO 2013). Useful information also comes from costing studies of related packages (Deogan, Ferguson, and Stenberg 2012; Temin and Levine 2009). Countries can modify this package depending on their specific needs and resource availability. Finally, we estimate what such a package might cost in 2012 U.S. dollars and provide brief conclusions. Definitions of age groupings and age-specific terminology used in this volume can be found in chapter 1 (Bundy, de Silva, and others 2017).

Corresponding author: Susan Horton, University of Waterloo, Ontario, Canada; sehorton@uwaterloo.ca.

METHODS

Our focus is on the costs and cost-effectiveness of certain areas of health of particular concern in adolescence. Topics we do not address are discussed in other volumes in this series:

- Human papillomavirus (HPV) (volume 3, Gelband and others 2015; volume 6, Holmes and others 2017)
- Reproductive health more generally (volume 2, Black and others 2016)
- Interventions in nonhealth areas, such as education and child marriage, that have strong impacts on health
- Conditional cash transfers (chapter 23 in this volume, de Walque and others 2017)
- Cost-effectiveness results from the second edition of *Disease Control Priorities* (*DCP2*), which included substantial modeling of interventions for smoking (Jha and others 2006), alcohol (Rehm and others 2006), obesity (Willett and others 2006), injury (Norton and others 2006), and mental health (Hyman and others 2006); these are all health issues for which adolescence is a particularly vulnerable age. *DCP2* included a chapter on adolescent health (Lule and others 2006) that reviewed the economic literature before 2000.
- Interventions covered in the chapter on school-age children (chapter 25 in this volume, Fernandes and Aurino 2017) are more appropriate with younger age groups, although some overlap occurs between school age and adolescence. Table 26.1 shows how the discussion is divided between this chapter and the preceding chapter on school-age children.

We searched the literature on the economics of interventions that were aimed specifically at adolescents or that would primarily benefit adolescents. The main areas where we anticipated finding studies included nutrition, sexual and reproductive health, mental health, alcohol, injury, and smoking and other addictive substances.

There are relatively few cost and cost-effectiveness studies on these topics in the peer-reviewed literature in English for LMICs. We drew first on systematic reviews of cost and cost-effectiveness for high-income countries (HICs), which were identified using a search in PubMed (see details in annex 26A). We identified seven such systematic reviews published since 2000.

We then undertook a systematic review of the literature in English for LMICs (see annex 26A for details) to identify individual studies since 2000. We augmented this review with an expert search and identified seven studies.

Table 26.1 Platforms for Delivering Different Interventions for Adolescents, Compared with School-Age Children

Health area	Population level	Community	School	Primary health center
Physical health	Healthy lifestyle messages: tobacco, alcohol, injury Sexual health messages	*Deworming* *Malaria prevention and treatment* *Tetanus toxoid and HPV vaccination* *Oral health promotion* Adolescent-friendly health services	*Deworming* *Malaria prevention and treatment* *Tetanus toxoid and HPV vaccination* *Oral health promotion* Sexual health education Healthy lifestyle education Adolescent-friendly health services	*Deworming* *Malaria prevention and treatment* *Tetanus toxoid and HPV vaccination* *Oral health promotion and treatment* Adolescent-friendly health services
Nutrition	Nutrition education messages	*Micronutrient supplementation* *Multifortified foods*	*Micronutrient supplementation* *Multifortified foods* *School feeding* Nutrition education	
Mental health	Mental health messages		Mental health education and counseling	Mental health treatment
Cognitive development		School promotion	*Vision screening*	*Vision screening*

Note: HPV = human papillomavirus. Blue colored interventions are covered in chapter 25 in this volume, Fernandes and Aurino 2017, on school-age children.

Costs and cost-effectiveness are expressed in the original currency units; for LMICs they are also converted to 2012 U.S. dollars, first by adjusting using the consumer price index in the currency of the studied country, and then using the 2012 market exchange rate to the U.S. dollar. The WHO (2001) benchmark for cost-effectiveness is the point at which an intervention's cost per disability-adjusted life year (DALY) averted is less than three times a country's per capita gross national income (GNI), and an intervention is very cost-effective if the cost per DALY averted is less than per capita GNI.

We did not convert the cost-effectiveness numbers for HICs. The benchmark for acceptability for public financing would be about US$50,000 per quality-adjusted life year (QALY) saved in the United States or £30,000 per QALY saved in the United Kingdom; we simply specify in the text whether the interventions are or are not cost-effective. All figures refer to 2012 U.S. dollars, unless otherwise noted.

Cost and cost-effectiveness studies do not cover all the areas of interest for adolescent health interventions. It is particularly difficult to find costs and cost-effectiveness of interventions at the national level (for example, for policy change or mass media campaigns), given that there is no easy way to identify the effectiveness of interventions in the absence of a control group. Clearly, however, interventions at the national level can be important. We also did not find studies of the cost and cost-effectiveness of social media, which may be an effective way to reach adolescents. These interventions are relatively new, and the literature may not yet have caught up.

UNIT COST, COST-EFFECTIVENESS, AND BENEFIT-COST RATIOS OF INTERVENTIONS

Given the relative neglect of adolescent health in LMICs, the paucity of economic analysis is not surprising. Even evidence of effectiveness of interventions is scanty. More pilot programs using innovative methods are needed, and existing successful pilot interventions need to be brought to scale.

Adolescents are also a diverse group, and interventions that succeed in some contexts may not do so in others. Some adolescents are in school, but others are not, and there are generally fewer cost-effective ways to reach those not in school. Some adolescents are married and face very different health challenges from those who are not. Adolescents living in rural areas face different circumstances than those in cities; there are also big differences across world regions, for example, in the experience of violence by adolescents.

Table 26.1 categorizes interventions by the type of delivery platform, as well as the broad program outcome; the four groupings are physical health, nutrition, mental health, and cognitive development. Many programs delivered in person need to be supplemented by national-level policy changes as well as by supportive messages in the media. Most programming for adolescents will be delivered either in the community or in school (for those in school).

Neuroscience has given us new insights into the difficulties in effecting behavior change in adolescents. In this age range, the brain develops in ways that stimulate innovation and risk-taking. Peer influence becomes increasingly important, and input from parents and adults less salient (see discussion in chapter 6 in this volume, Bundy and Horton 2017, and chapter 10 in this volume, Grigorenko 2017). Risk-taking may have evolutionary benefits, in that this is the period in which adolescents have traditionally been expected to leave the parental home and set up a new, independent household. Risk-taking also has a downside, in that executive control functions are still developing and can be overridden in the heat of the moment, particularly in the company of peers. Steinberg (2007) suggests that interventions limiting the scope of potential damage may work better than education alone. For example, graduated driving licenses may more successfully reduce automobile injuries than educational programs about safe driving behavior. At the same time, adolescence is such a crucial time for establishing habits and behaviors with lifelong consequences that it would seem impossible not to include educational interventions.

Two methodological issues affect the economic evaluation of school-based interventions. First, the same intervention can vary substantially in quality depending on the context in which it is implemented, and hence also in effectiveness. Second, very few school-based programs track outcomes longitudinally. This shortcoming is particularly an issue for the myriad studies of obesity; short-term weight gain outcomes may be a very poor guide to long-term outcomes. Lack of longitudinal studies may be less of an issue in the areas of smoking and early pregnancy. In both cases, avoiding the risky behavior for three or four years may suffice to avoid the undesired outcomes. Adolescents who reach early adulthood without becoming smokers are substantially less likely to become lifelong smokers. Similarly, postponing first pregnancy until the end of the teenage years can have a significant effect on schooling attainment for young women as well as health benefits for both the young women and their babies.

Findings for High-Income Countries

Our literature search identified six systematic reviews for HICs (Guo and others 2010; Korber 2014; Romeo, Byford, and Knapp 2005; Shepherd and others 2010; Vos and others 2010; Wu and others 2011). We also draw on nonsystematic reviews by De la Cruz and others (2015) and McDaid and others (2014). Given the amount that is spent on, for example, educational programs, it is surprising that the cost-effectiveness literature is relatively spotty.

Obesity

For HICs, we identified two systematic reviews of cost-effectiveness of physical activity as a way to address obesity (see table 26.2) (Korber 2014; Wu and others 2011); McDaid and others (2014) also reference studies on obesity. These three reviews identify some interventions that are cost-effective and others that are not. In some cases, interventions that are cost-effective are costly and may not be affordable (Wu and others 2011). De la Cruz and others (2015) surveyed individual studies

Table 26.2 Summary of Reviews of Cost-Benefit and Cost-Effectiveness of Interventions for Adolescent Health, High-Income Countries

Study	Scope of review or study	Study findings
Guo and others 2010	Study of school-based **health care** in four school districts in the United States	• School-based health care could have saved Medicare US$35 per student per year; cost of intervention US$180 per student per year for children and adolescents ages 5–14 years. • School-based care also narrowed gap between disadvantaged groups (African American) and other students.
Korber 2014	Systematic review of 13 economic evaluations of interventions to promote **physical activity**	5 studies of United States, 4 Australia, 2 Germany, 1 United Kingdom, 1 New Zealand • Cost per DALY averted for Australia ranged from $A 20,227 to $A 760,000 per DALY (Walking School Bus). • Cost per QALY saved for United States ranged from US$900 to US$4,305. • Cost per QALY saved for United Kingdom was £94–£103.
McDaid and others 2014	**Alcohol**: Review of 2 studies	• Education sessions with 11–12-year-olds and parents (one study) have a benefit-cost ratio of 9:1; various interventions (other study) have benefit-cost ratios ranging from 5:1 to 100:1 in United States.
McDaid and others 2014	**Smoking:** Review of 7 studies, largely school based (2 include mass media as well)	• The Netherlands: Cost US$25,174 per QALY saved • Germany: 3.6:1 benefit-cost ratio • United States: (4 studies) US$5,860–US$405,277 per QALY saved; US$7,333–US$24,271 per QALY saved; highly cost-effective; and cost-effective or cost saving, respectively • Canada: Results similar to United States
McDaid and others 2014	**Sexual health:** 1 study	• Net savings for a program to prevent early pregnancy among adolescents in low-income areas in United States is US$11,262 per participant.
McDaid and others 2014	**Mental well-being:** 5 studies	• US$3,500 per DALY for program to screen Australian teenagers with depressive symptoms and treat with psychiatrist • US$9,725 per DALY for program in United States to offer 15 sessions of CBT to at-risk teens ages 13–18 years with one parent with depressive disorder • Three interventions to promote well-being in schools in United States had benefits of 28:1, 5:1–10:1, and 25:1 for reduced drug dependency, smoking, and delinquency, respectively.
McDaid and others 2014	**Obesity prevention:** 3 studies	• Various programs in Australia were cost saving over lifetime; others (Walking School Bus, gastric banding, and drug therapy) were not. • Program in United States to reduce TV watching, improve physical activity, and improve diet effective in girls at cost of US$5,076 per QALY saved. • Study in United Kingdom found lifestyle interventions effective at cost of US$20,589 per QALY saved.

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Table 26.2 Summary of Reviews of Cost-Benefit and Cost-Effectiveness of Interventions for Adolescent Health, High-Income Countries (continued)

Study	Scope of review or study	Study findings
Romeo, Byford, and Knapp 2005	Systematic review of **mental health interventions** for children and adolescents	21 studies: 10 United States, 4 United Kingdom, 3 Canada, 1 Australia, 1 Sweden, 1 Norway, and 1 the Netherlands • Programs heterogeneous in design and in outcome measures, not readily converted to a common health outcome metric.
Shepherd and others 2010	Systematic review of school-based interventions for prevention of transmission of **sexually transmitted infections**; modeled for economic cost-effectiveness	• Examined 15 RCTs: 13 for United States, 2 for United Kingdom • Review found significant changes in knowledge and in some measures of self-efficacy but few significant differences in behavior (only short follow-up). • Estimated cost of teacher-led programs at £4.30/pupil; peer-led £15/pupil; incremental cost-effectiveness ratio £20,223 per QALY saved for teacher led; £80,782 per QALY saved for peer led
Vos and others 2010	Modeling of cost-effectiveness of broad range of interventions for Australia (costs in $A); **drugs and mental well-being**	• School-based program for illicit drug education cost $A 59,000 per DALY averted. • Screen and treat with a psychologist in school for child and adolescent depression cost $A 5,400 per DALY averted. • Screen and treat with bibliotherapy in school for child and adolescent depression cost $A 180 per DALY averted, but evidence of effectiveness limited.
Wu and others 2011	Systematic review and cost-effectiveness of programs to promote **physical activity**	91 studies (141 interventions) of which 48 RCTs; predominantly for United States, almost all for HICs. Of these, the cost per MET per person per year varied considerably: • Point-of-decision prompts had the lowest cost per MET but very small effect on overall physical activity levels. • School and community-based programs had middle cost per MET and middle effect on physical activity levels. • Individually adapted behavior change and social support programs had highest cost per MET but highest effect on physical activity levels.

Source: Horton 2015.
Note: Costs are in year of original study. CBT = cognitive behavioral therapy; DALY = disability-adjusted life year; HICs = high-income countries; MET = Metabolic Equivalent of Task; QALY = quality-adjusted life year; RCTs = randomized controlled trials.

for HICs and identified two studies for obesity: Haynes and others (2010) suggesting that reducing consumption of carbonated drinks can be very cost-effective; and Carter and others (2009), indicating that physical activity promotion is cost-effective, although barely.

Smoking, Alcohol Use, and Illicit Drug Use

No systematic reviews were identified for smoking, alcohol use, or illicit drug use. Individual studies may not include keywords related to adolescence, although it is well understood that adolescence is a key period for experimentation with (and in some cases becoming addicted to) these substances. For the United States, there are examples of cost-effective, as well as cost-ineffective, smoking prevention interventions for adolescents (surveyed in McDaid and others 2014). De la Cruz and others (2015) highlight one study for smoking, in which increased cigarette taxation combined with subsidies for quitting aids has attractive cost-effectiveness ratios in the Netherlands (Over and others 2014). Vos and others (2010) survey examples of programs to prevent or reduce use of illicit substances, some of which are cost-effective.

Reproductive and Sexual Health

Two systematic reviews (Guo and others 2010; Shepherd and others 2010) cover school-based health care, which often has a focus on sexual and reproductive health, and at times, on mental health. Some school-based programs are cost-effective in preventing sexually transmitted infections (Shepherd and others 2010). Some school-based interventions on reproductive health are even cost saving (Guo and others 2010), as was one program aimed at preventing early pregnancy among adolescents living in a low-income area (McDaid and others 2014).

Mental Health

School-based programs can also be effective for mental health (Romeo, Byford, and Knapp 2005), although cost may make them difficult to afford. De la Cruz and others (2015) identify a study combining cognitive behavioral therapy with a change in medication that improves mental health, but this intervention is not quite cost-effective (Lynch and others 2011).

Overall Findings

In each of the reviewed health areas in HICs, it is possible to find some interventions for adolescents that are cost-effective, using the country's own threshold, and others that are not. Lack of cost-effectiveness has several causes, among them, poor implementation, poor monitoring, and poor design. Monitoring behavior change interventions is more challenging than, for example, monitoring vaccinations. Poor design may arise when modeling or communicating behavior changes in ways that do not appeal to adolescents. Some interventions may be effective but relatively high cost, so that even if they are cost-effective, they are not affordable.

The lessons from HICs are that schools are an appropriate venue for interventions since adolescence is a key age at which interventions should occur; however, it is crucial to have programs that are well conceptualized, well targeted, and well implemented. Programs need to be evidence based. In the United States, the Department of Health and Human Services (2014) funds evaluations for pilot programs and lists the types of evidence required for a program to be eligible for evaluation. As outlined in the methodology section, implications have to be drawn cautiously. The context of HICs differs from that of LMICs; and even in HICs, the number of studies with long-term follow-up is limited.

Findings for Low- and Middle-Income Countries

We identified seven studies in LMICs, most of a single country, but one has results for six middle-income countries (MICs). Two are of obesity; four are of sexual and reproductive health; and one is of smoking prevention (table 26.3). Most of the studies were conducted in MICs.

Obesity

For MICs, school-based interventions to reduce obesity are affordable at less than US$1 or US$1.50 per person in the overall population; however, they are not cost-effective, according to Cecchini and others' (2010) comprehensive modeling study of interventions in MICs. In comparison, restrictions on the advertising of food to children cost about one-tenth as much per person in the population; although only marginally cost-effective over a 20-year horizon, these restrictions become cost saving or cost-effective or very cost-effective in all the countries over a 50-year horizon. Cecchini and others (2010) also model five other interventions aimed at adults that are not discussed here.

A large trial of school-based interventions in China (Meng and others 2013) finds that nutritional or physical activity interventions alone are not effective, but a combined program is effective, albeit not significantly so. This observation that comprehensive interventions are required is consistent with the general literature on obesity prevention that is not restricted to children and adolescents or to LMICs. Meng and others (2013) do not calculate cost-effectiveness per DALY or QALY. Accordingly, it is not possible to infer whether the intervention is cost-effective; however, it is not inexpensive at US$4.41 per participant over two years, and at US$31.10 if teachers' time is included. In comparison, per capita annual health expenditure from the public budget in 2013 was, on average, US$15.36 for low-income countries, US$30.67 for lower-middle-income countries, and US$260.96 for upper-middle-income countries (World Bank 2016).

Smoking

Findings from a study of a school-based intervention for smoking in India (Brown and others 2012) are similar. Although the program is cost-effective per QALY saved, the cost of US$45.81 per student is not inexpensive; removing the cost of teachers' time reduces the cost of this particular intervention by only 5 percent. This was a large-scale pilot; it is possible that costs could be reduced by embedding the training involved into the regular teacher training curriculum rather than delivering it via special workshops that require travel and per diem expenses.

Reproductive and Sexual Health

Of the four studies of interventions for sexual and reproductive health, only one (Duflo and others 2006) provides cost-effectiveness estimates. Their findings suggest that providing adolescent girls with information they can use to make more informed decisions (advising them of the age profile of human immunodeficiency virus/acquired immune deficiency syndrome [HIV/AIDS] status in men) is the most cost-effective at US$253 per DALY averted. More general educational interventions regarding HIV/AIDS, and subsidies designed to help girls stay in school also fall into the very cost-effective zone for Kenya at less than one times per capita GNI (WHO 2001). Unit costs are modest; Duflo and others (2006) do not present unit costs for the curriculum-based

Table 26.3 Cost And Cost-Effectiveness of Interventions Relevant for Adolescent Health in Low- and Middle-Income Countries, from Systematic Review

Study	Country/region	Intervention/condition	Cost per unit as presented in article	Unit	Currency (year)	Cost per unit in 2012 US$
Obesity						
Cecchini and others 2010	Brazil, China, India, Mexico, Russian Federation, South Africa	Modeling effects of two interventions aimed at obesity at school age, and five others aimed at adults:				
		• School-based interventions	0.82 (Brazil)	Per head of population	2005 US$	1.44
			0.53 (China)			0.86
			0.73 (India)			1.09
			1.22 (Mexico)			1.35
			0.51 (Russian Federation)			0.87
			0.99 (South Africa)			1.19
		• Food advertising regulations for children	0.04 (Brazil)	Per head of population	2005 US$	0.07
			0 (China)			0
			0 (India)			0
			0.09 (Mexico)			0.10
			0.13 (Russian Federation)			0.22
			0.08 (South Africa)			0.10
		• School-based interventions (20-year horizon)	> 1 million (except Russian Federation)	Per DALY averted	2005 US$	> 1 million in all countries
			830,177 (Russian Federation)			
		• Food advertising regulations for children (20-year horizon)	CS (Brazil)	Per DALY averted	2005 US$	CS
			556 (China)			902
			3,186 (India)			4,753
			11,151 (Mexico)			12,340
			5,718 (Russian Federation)			9,725
			13,241 (South Africa)			15,892

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Table 26.3 Cost And Cost-Effectiveness of Interventions Relevant for Adolescent Health in Low- and Middle-Income Countries, from Systematic Review (continued)

Study	Country/region	Intervention/condition	Cost per unit as presented in article	Unit	Currency (year)	Cost per unit in 2012 US$
		• School-based interventions (50-year horizon)	93,350 (Brazil)	Per DALY averted	2005 US$	174,918
			35,174 (China)			57,031
			59,665 (India)			89,009
			235,957 (Mexico)			261,123
			261,114 (Russian Federation)			444,098
			153,233 (South Africa)			183,911
		• Food advertising regulations for children (50-year horizon)	CS (Brazil)	Per DALY averted	2005 US$	CS
			CS (China)			CS
			752 (India)			1,122
			658 (Mexico)			728
			4,823 (Russian Federation)			8,209
			3,352 (South Africa)			4,023
Meng and others 2013	China	Combined nutrition and physical education intervention in schools (also reports nutrition alone, physical education alone; no significant effect)	26.80	Per student	US$ (year not given; likely 2009–10)	31.10
			3.80 excluding cost of time of teachers			4.41 excluding cost of time of teachers
			1,308.90	Per case of overweight or obesity averted	US$ (year not given; likely 2009–10)	1,519
Sexual and reproductive health						
Duflo and others 2006	Kenya	• Education of school students on HIV/AIDS (cost $9 per student in a specific grade in 2003, estimated by authors of this chapter)	575	Per pregnancy averted (proxy for unprotected sex)	US$ (year not given; likely 2003)	1,600
		• Informing girls in school of age profile of HIV in men	91	Per pregnancy averted	US$ (year not given; likely 2003)	253
		• Free school uniforms once in each of two years for grade 6 students (uniform cost $6 in 2003)	749 (full cost)	Per pregnancy averted	US$ (year not given; likely 2003)	2,084

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Table 26.3 Cost And Cost-Effectiveness of Interventions Relevant for Adolescent Health in Low- and Middle-Income Countries, from Systematic Review (continued)

Study	Country/region	Intervention/condition	Cost per unit as presented in article	Unit	Currency (year)	Cost per unit in 2012 US$
Kempers, Ketting, and Lesco 2014	Moldova	Adolescent-friendly sexual and reproductive health services	2.55	Per person in population covered	2011 US$	2.59
			12.10	Per user		12.58
Kivela, Ketting, and Baltussen 2013	Nigeria	School-based intervention for sexuality education (costs for pilot programs also for India, Indonesia, and Kenya)	7 (Nigeria)	Per student	2009 US$	9.40
Terris-Prestholt and others 2006	Tanzania	An adolescent sexual health program, with school-based education component plus condom distribution	13.46	Per student	2001 US$	17.92
			1.54	Per condom distributed		2.05
Smoking						
Brown and others 2012	India	School-based education intervention against smoking (MYTRI)	31.73 per student for 2-year program	Per student	2006 US$	45.81
			2,492	Per QALY	2006 US$	3,598
			(2,769 if students' time included)			(3,998 if students' time included)

Note: CS = cost saving; HIV/AIDS = human immunodeficiency virus/acquired immune deficiency syndrome; MYTRI = Mobilizing Youth for Tobacco-Related Initiatives in India.

interventions, but calculations using their data suggest these cost approximately US$25 per student in one grade. Duflo and others (2006) present figures for a subsidy to keep students in school of 2012 US$16.69 per student (cost of a uniform) per year, and US$33.38 for the intervention that provided uniforms in two different years.

Two other studies provide costs per student for educational interventions on sexual and reproductive health. Kivela, Ketting, and Baltussen (2013) examine costs in four LMICs; for a program at scale in Nigeria; and pilot programs in India, Indonesia, and Kenya. The two extracurricular programs in Indonesia and Kenya cost significantly more than the intracurricular ones. Costs were US$85 and US$205 per student, respectively, compared with US$9.40 in Nigeria, and US$16.30 in India. The budgetary outlays were a quarter or less of the total cost for the three countries with intracurricular programs because governments are already paying teachers' salaries. International standards recommend that there should be 12–20 lessons of 45–60 minutes each, spread over more than one year, for such interventions to be effective.

Kivela, Ketting, and Baltussen (2013) point out some of the issues of including sexuality education in the curriculum. Their study notes that opposition to the programs in India and Nigeria caused implementation delays of several years, with attendant increased costs.

A study for Tanzania (Terris-Prestholt and others 2006) estimated that an adolescent sexual health intervention cost US$17.92 for the school-based education component. Other components included adolescent-friendly health services, peer distribution of condoms, and community mobilization efforts; the educational component accounted for 70 percent of the costs. Information about the net budgetary cost was not presented, including how much of the educational program cost was allotted to teacher's salaries when presenting the program, as opposed to the additional costs for teacher training.

The last study of sexual and reproductive health (Kempers, Ketting, and Lesco 2014) presents the cost of an adolescent-friendly sexual and reproductive health service in Moldova. Four well-performing centers were picked for study out of 38. The centers provide services for sexually transmitted infection, early pregnancy and contraception, and HIV/AIDS. Costs were US$6.14 per visit; assuming each participant required on average two visits, the cost was US$12.58 per user per year. Slightly less than 20 percent of the covered youth population used the services, such that the cost per young person in the population covered was US$2.59.

Although the youth-friendly health services in Moldova were potentially cost saving for potential numbers of sexually transmitted infections averted, unwanted pregnancies averted, and cases of HIV/AIDS averted, funding the services was difficult. A little more than 50 percent of the cost came from the National Health Insurance Company; services also relied on contributions from donors, nongovernmental organizations, and local authorities, as well as substantial amounts of volunteer time.

Implications for Program Development

This review of evidence from HICs and LMICs provides some guidance for the economics of an essential package of interventions. At the same time, we must recognize that evidence on what works is still being amassed.

First, data are simply insufficient in a number of areas, including national media campaigns, national policy making, and social media, which are likely all important ways to support any intervention delivered to individual adolescents. The modeling results on restrictions on food advertising to young people (Cecchini and others 2010) are promising, but the estimated effectiveness of advertising interventions relies on very limited evidence.

Second, programs delivered through schools are a mainstay (Bundy, Schultz, and others 2017). Their unit costs are not inexpensive, but school-based programs may be less costly than community-based ones. Costs of educational programs in schools can be reduced by providing intracurricular programs at scale and incorporating training into the teacher education curriculum. Teacher involvement in educational interventions is crucial, and effective training can reduce costs and improve affordability in the long term. At the same time, neuroscience suggests that education programs alone are insufficient in areas in which adolescents make "hot" decisions. Education may need to be complemented with risk reduction efforts based on behavioral theory and skill development. The likelihood of success for simply preventing an undesirable outcome for a few years may be higher than that for establishing lifelong healthy habits.

One limitation of the evidence is that education programs are very heterogeneous. Program design, context, and intensity of effort in implementation all matter. Another limitation is that the duration of follow-up studies of school-based interventions is usually short. Thus, evidence on long-term impact is lacking. This differs from the literature on early childhood development and preschool interventions, where there are a modest number of high-quality research studies with long-term follow-up, both for HICs and LMICs (see chapter 19 in this volume, Black and others 2017, and chapter 24 in this volume, Horton and Black 2017).

Finally, youth-friendly health services may be important and cost-effective, but they are time intensive to deliver, and issues of affordability in LMICs may arise.

COSTING AN ESSENTIAL PACKAGE

Promoting adolescent health requires a broad range of actions across several sectors. Education is key and affects skills and employment opportunities; for girls, education helps delay marriage and early childbearing. Policies and laws that allow flexibility in adolescents' access to health services without necessarily requiring parental authorization are vital, as are policies and laws controlling their exposure to unhealthy products and activities (Laski and others 2015). Empowerment and involvement of adolescents in decision making concerning their well-being is essential. Although ministries of health will be involved in promoting adolescent health in all of these areas, they will not necessarily lead the efforts.

The focus of this chapter is on the more narrowly defined interventions to promote adolescent health in which ministries of health have the primary responsibility. The adolescent package costed here draws on several other sources. The WHO (2013) provides policy advice on programs for preconception care, which overlaps substantially with the initiatives discussed in the previous section. Patton and others (2016) include recommendations for adolescent health as well as other supportive nonhealth services. The Global Strategy for Women's, Children's and Adolescents' Health (Every Woman Every Child 2015) includes recommendations in five priority areas for adolescent health interventions (Laski and others 2015).

Two other studies provide cost estimates. The Centre for Global Development's *Start with a Girl* discusses an agenda for adolescent girl health that was also costed (Temin and Levine 2009). Deogan, Ferguson, and Stenberg (2012) provide estimates for a package of adolescent-friendly health services, as well as the cost of providing this package in 74 LMICs. These services are one component of a desirable package for promoting adolescent health.

The WHO's (2013) guidelines on preconception care recommend interventions in 13 areas. These areas are primarily directed at women but apply to older adolescent girls, given the younger age at first birth in many LMICs. The areas comprise the following:

- Nutritional conditions
- Vaccine-preventable diseases
- Genetic conditions
- Environmental health
- Infertility and subfertility
- Female genital mutilation
- Too early, unwanted, and rapid-succession pregnancies
- Sexually transmitted infections
- HIV/AIDS
- Interpersonal violence
- Mental health
- Psychoactive substance use
- Tobacco use.

Nutritional conditions and vaccine-preventable diseases are discussed in the package for school-age children (Fernandes and Aurino 2017); others are consistent with topics discussed in this chapter.

Priority actions for adolescent health in the Global Strategy for Women's, Children's and Adolescents' Health are summarized by Laski and others (2015) as follows:

- Health education, including comprehensive sexuality education
- Access to and use of integrated health services
- Immunization
- Nutrition, including healthy eating and exercise, and supplementation of key micronutrients
- Psychosocial support for detection and management of mental health problems.

Start with a Girl is an ambitious agenda with eight components recommended for adolescent girls in LMICs (Temin and Levine 2009). The total package is US$359.31 per girl per year. (We have not updated their cost estimates to 2012 since doing so is not straightforward for a multicountry estimate). The eight components specific to girls, with associated costs per girl per year, are youth-friendly health services (US$8.50), iron supplements (US$2.00), HPV vaccination (US$17.50), reducing harmful traditional practices (US$80.85), male engagement (US$113.85), obesity reduction (US$0.11), edutainment programs (US$0.57), safe spaces (US$130.51), and comprehensive sexuality education (US$6.02). The edutainment intervention, which combines computer games with educational elements, is directed at issues of sexual and reproductive health, gender-based violence, and other health challenges facing girls. The ninth component is male engagement for young men ages 15–24 years living on less than US$2 per day (US$113.25). Smoking reduction is not costed because it is expected that revenue from higher taxation would more than cover interventions. This package is somewhat different from what is costed in this chapter. It is, on the one hand, much more comprehensive; on the other hand, it does not consider the health of male adolescents.

Deogan, Ferguson, and Stenberg (2012) have undertaken a comprehensive costing of adolescent-friendly health services for 74 countries. The package includes contraception; maternity care; management of sexually transmitted infections; HIV/AIDS testing and counseling, harm reduction, and care and treatment; safe abortion services; and care of injuries due to intimate partner violence and sexual violence. It also includes costs of activities to improve quality of care and increase uptake of services by adolescents. Once full coverage is achieved, the cost is estimated to be US$4.70 per adolescent, or US$0.82 averaged over the whole population. There is some degree of overlap between costs for adolescent-friendly health services; estimates of expanding contraceptive services are discussed in volume 9, chapter 3 (Watkins and others 2018). The overall cost of US$4.3 billion in aggregate covers 74 countries. We have not converted these figures to 2012 U.S. dollars because their projections are in current U.S. dollars for 2011–15 and the conversion would not be straightforward.

The essential package costed in this chapter draws on the economic assessment of existing interventions and the key interventions outlined in recent strategy documents where ministries of health have a leading or major role. The package that we cost includes the following components:

- Adolescent-friendly health services
- School-based educational programming covering such topics as sexual and reproductive health, mental health, smoking, alcohol, and illicit drugs
- National media and policy efforts to support a healthy lifestyle program to complement school-based programming

These interventions correlate fairly well with the burden of disease in adolescence: the top five causes of death are road injury, HIV/AIDS, suicide, lower respiratory infections, and interpersonal violence; and the top five causes of years lived with disability are depression, road injuries, anemia, HIV, and suicide (WHO 2014). Because road traffic injuries are an important topic in volume 7 of this series (Mock and others 2017), they are not discussed in the present chapter.

We use Deogan, Ferguson, and Stenberg's (2012) estimates for adolescent-friendly health services. We use Ebbeler's (2009) estimates for the national media cost for a sexuality education campaign of US$0.58 per girl or boy reached, and we assume that double this amount could incorporate a more comprehensive campaign against various harms. Ebbeler's (2009) estimates provide the detailed assumptions underpinning the costing in Temin and Levine's (2009) *Start with a Girl*.

Finally, we use estimates from the previous section for the costs of school-based education programs. Three programs (table 26.3) cost US$9, US$18, and US$25, approximately. The Indian antismoking program (Brown and others 2012), at almost US$46, relies heavily on per diem and travel costs as a start-up, and it is unrepresentative of what a mature program might cost. We include a cost of US$18 per adolescent per year and assume that adolescents would participate in such a program each year for three years (ages 14–16 years). Of this cost, 25 percent represents additional budget costs to the government of developing the program, training the trainers, and refreshing the curriculum periodically; the balance is the cost of teachers' time. We specifically exclude obesity from the educational package. The evidence base is weak, and current programs are not unequivocally effective. This is an area where more pilot programs and evaluations are required.

The cost of the recommended package is as follows:

- US$4.70 per adolescent ages 10–19 years for adolescent-friendly health services
- US$1.16 per adolescent ages 10–19 years for national media campaigns and national policy efforts
- US$9.00 per adolescent ages 14–16 years for the net budget cost of a school-based education program, excluding cost of teachers' time; this amount is equivalent to US$3.00 per adolescent ages 10–19 years.

The total package, therefore, costs roughly US$8.90 per year for each adolescent ages 10–19 years.

Deogan, Ferguson, and Stenberg's (2012) estimate for adolescent-friendly health services is carefully constructed using detailed data; the other two items are simply rough estimates and require further refinement. Costs of the total package are aggregated by size of population in low-income and lower-middle income countries in chapter 1 (Bundy, de Silva, and others 2017).

CONCLUSIONS

Adolescent health, overlooked for years, is now achieving much-needed prominence in the international health agenda. Adolescence is a key point in the life course, a point at which important health behaviors are established that determine the path of chronic disease at older ages. It is a key time at which to invest in and benefit the health of the working-age population, older adults, and through new mothers and their babies, the next generation. The relative neglect of adolescents in research and programming means that knowledge of how to design

cost-effective programs is inadequate relative to needs. This is an area in which there may be a payoff to trying innovative approaches and in which pilot programs require rigorous evaluation.

Economic evaluations for HICs suggest that a number of health interventions for adolescents can be cost-effective or very cost-effective, including screening and treating for selected mental health conditions as well as school-based programs on education regarding smoking, alcohol, and sexual health. Whether interventions aimed at obesity are cost-effective is uncertain because data on long-term outcomes are lacking.

For LMICs, we were able to find only two cost-effectiveness studies using QALYs or DALYs as outcomes. One concluded that restrictions on advertising of unhealthy foods was cost-effective (or even cost saving) in preventing obesity across a range of countries, while school-based interventions were not. The other study concluded that a school-based antismoking pilot program in India was cost-effective, although not very cost-effective; it is likely that if it became part of the routine curriculum it could become less costly and therefore likely more cost-effective.

An essential package for adolescent health should include at least three elements: national-level policy combined with communication of social norms, accessible and respectful services, and targeted education. National and subnational governments need to create an appropriate environment through legislation and through social marketing of key messages. Access to services that recognize adolescents' desires for confidentiality and treat them respectfully will facilitate uptake. Education in health and wellness will provide this group with the means to be active participants in their own health and improve outcomes. This education can be provided in schools as well as in other venues where it is cost-effective to reach those who are no longer in school. These elements need to be complemented with broader social policy and initiatives outside the health area that affect adolescent well-being.

The essential package in this chapter costs approximately US$8.90 per adolescent in lower-middle-income countries (in 2012 U.S. dollars). The costs will be somewhat higher in upper-middle-income countries. Compared with per capita annual public health expenditure of US$31 in lower-middle-income countries in 2013 (World Bank 2016), this amount is not unreasonable. Low- and lower-middle-income countries, in particular, face pressing unmet needs for treatment of existing illnesses. The economic evidence summarized in this chapter can help make the case for the substantial returns on preventive investments in adolescent health.

The future research needs are large, given the paucity of existing evidence. Cost-effectiveness studies should be undertaken for promising pilot programs before they are scaled up. It is not too difficult to collect cost information retrospectively to calculate cost-effectiveness or the benefit-cost ratio if a program proves to be effective. Another priority is for longitudinal studies, particularly for the rapidly growing problem of obesity, but there is considerable uncertainty about whether school-based programs have any lasting effect. A third knowledge gap is how to reach adolescents who are not in school. It is possible that social media and mass media can be used innovatively to reach this group, and perhaps the health sector can learn how to design appealing health messages from advertisers of commercial products.

ANNEX

This annex to this chapter is as follows. It is available at http://www.dcp-3.org/CAHD.

- Annex 26A. Methodology and Results of Systematic Search, Cost-Effectiveness Analysis

NOTE

World Bank Income Classifications as of July 2014 are as follows, based on estimates of gross national income (GNI) per capita for 2013:

- Low-income countries (LICs) = US$1,045 or less
- Middle-income countries (MICs) are subdivided:
  a) lower-middle-income = US$1,046 to US$4,125
  b) upper-middle-income (UMICs) = US$4,126 to US$12,745
- High-income countries (HICs) = US$12,746 or more.

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