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Health benefits of eliminating child labour

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International Programme on the Elimination of Child Labour (IPEC)

ILO/IPEC Working Paper

Health benefits of eliminating child labour

Research paper in conjunction with the ILO-IPEC Study on the Costs and Benefits of the Elimination of Child Labour

by

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Preface

The author is Associate Professor in the Social Medicine Department at the Federal University of Pelotas, Brazil.

The views and interpretations in this report are those of the author and do not necessarily reflect those of the ILO.

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Contents

Executive summary

It is a distressing fact that hundreds of millions of children throughout the world are forced into labour on a daily basis. Although the reasons that these children must work are varied and diverse, there is a consistent pattern through nearly all of their cases, namely that child labour has a direct impact on their health.

The present report, prepared for the International Labour Organization by Anaclaudia Gastal Fassa at the Federal University of Pelotas (Brazil), examines the root causes of child labour, and researches its impact on the well-being of children around the world.

International standards define a child as a person under the age of 18, and recent estimates suggest that over 350 million children worldwide are economically active today. The information reveals that more than 200 million of those children are between the ages of 5 and 14, over half of them engaged in hazardous occupations. Another 141 million children aged between 15 and 17 are working, out of whom 42 per cent are in hazardous conditions.

There is a lack of accurate data on the percentage of child workers in each major industry division. However, we know that most of the 5-14-year-olds find themselves in agriculture and services, while the 15-17-year-olds mainly work in the services, manufacturing and retail sectors.

Agricultural work, according to a 1995 study, is consistently ranked among the top three most hazardous industries for mortality and morbidity. Farmworkers routinely use knives, hoes and other cutting implements. They also operate heavy machinery and work on ladders. Exposure to such equipment is extremely hazardous to the health of young children.

In addition, children working in agriculture are often heavily exposed to pesticides. Frequently, they are not wearing protective gear, like gloves and masks. Further, the food they are given could be contaminated with high traces of pesticides, and the water in which they bathe also could be contaminated.

While estimates of pesticide poisoning among child farmworkers are not available, estimates for all ages indicate the importance of the problem. The United States Environmental Protection Agency has indicated that nearly 300,000 farmworkers suffer pesticide poisoning annually. Additional health problems could stem from the long and arduous hours, which have led to heat illness, and in several cases even death, in a number of child workers.

While it may be the most prevalent industry for child labour, agricultural is not alone in posing risks to child workers. Large numbers of children are also employed in mining, which results in a large number of respiratory problems; manufacturing, whose common hazards include exposure to dangerous machinery, exposure to noise, exposure to chemical substances, an awkward posture, repetitive movements, and heavy loads, among others; prostitution, in which the children are at risk for, among other things, drug addiction and HIV/AIDS; child soldiers, many of whom serve as combatants in the most violent areas of the world; and many other hazardous activities.

One of the most effective protectors against child labour is improved education. This involves education for all participants – the child, the parents and the employers.

Clearly, there is a strong association between socio-economic status and education, thereby making it difficult to separate their effect on health. It would be uncommon to find economically privileged children facing child labour and thus being exposed to the inherent risk. Still, most researchers maintain the link between education and health.

Educated people, for example, would be more likely to use modern health facilities, both for preventive and curative purposes. The studies cited mainly show a positive correlation between maternal education and the use of health services, such as prenatal care, delivery assistance and attendance at maternal and child health clinics.

With early exposure to positive health practices, the first stages of a child's life are likely to establish a groundwork of healthy choices that could ultimately lead to educational success, financial stability and personal best practices that may help reduce the frequency of child labour across the world.

Introduction

This working paper is a component of an ILO/IPEC project to calculate the costs and benefits of the elimination of child labour. It discusses the potential health benefits to be obtained from eliminating child labour, examining the health benefits of more widespread education as well as the elimination of the worst forms of child labour in particular.

- Chapter 1 presents a review of the relationship between more widespread education and health. It describes the conceptual framework of this relationship and the evidence for association between these two factors of social development. World Bank data is analysed in order to obtain a generalized method of measuring the educational impact on health.

- Chapter 2 proposes a formula for estimating the educational impact on health, based on country-level data. An example of the application of the formula estimates the effect of fully achieved universal primary and secondary enrolment on the decrease of the disability adjusted life years (DALY) in low- and middle-income countries.

- Chapter 3 reports the evidence for the relationship between specific worst forms of child labour and present and future health outcomes.

- Chapter 4 provides the formulae to convert health outcomes to DALY.

- The appendix contains all tables referenced in the main body of the text.

I. Correlation between education and health

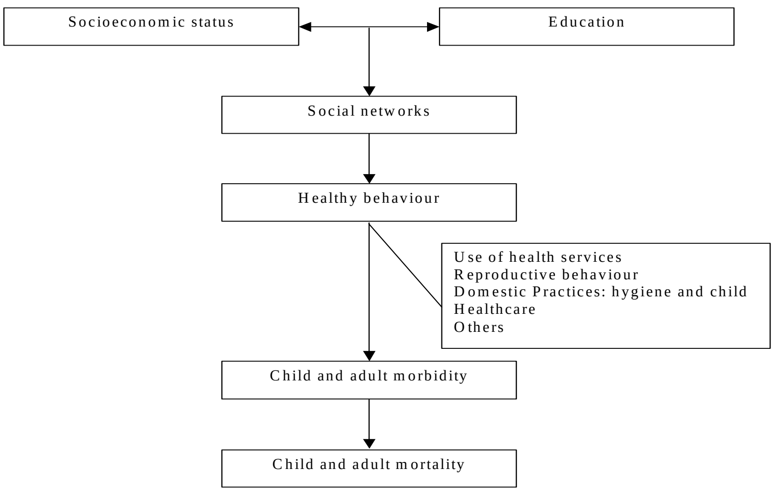
A great number of studies, with different research methods, time periods and population samples show that households with more education enjoy better health both for adults and for children (WDR, 1993). Most of the evidence relates maternal education to child survival, but there is also some evidence relating maternal education to child growth, as well as the education of both sexes to healthy behaviour (Bicego et al., 1993; Cleland et al., 1988 ; Barrett et al., 1996; WDR, 1993).

Despite the apparent positive effect of education on health, the intervening factors on this relationship are not well established (Barrett et al., 1996). The links between education and health are very complex, and the available evidence is patchy and sometimes inconsistent (Cleland et al., 1988). These inconsistent findings could be related, in part, to the difference in cross-cultural dimension among the populations surveyed in several studies, pointing to variable causal mechanisms in different settings. Moreover, most of the research was not specifically designed to study the relationship between education and health and frequently does not have detailed information to explore the mechanisms of the association.

1. Conceptual framework

The conceptual framework presented in figure 1 shows the mechanisms that link education and health. Education has a bidirectional relationship with socio-economic status. Both of these variables have an impact on the social networks an individual is able to develop. Furthermore, education, socio-economic status and social networks will determine the adoption of healthy behaviour that has a positive impact on child and adult morbidity and mortality.

Figure 1. Conceptual framework



Education is sometimes acknowledged as a mark of an exceptional background and of distinctive social status or psychological characteristics that are merely reinforced by formal schooling. This is particularly important for females, due to their restricted access to schooling in some countries. However, according to Cleland (1988), just a small part, if any, of the education/mortality association could be attributed to education effect as a marker. The persistence of the education/mortality association in societies that vary widely in access to schooling and in levels of adult female literacy suggests that this selection bias is not of major importance.

There is a strong colinearity between socio-economic status and education, which makes it difficult to separate their effect on health. However, most authors believe that the association between education and health is independent from socio-economic factors (Ferguson, 1993). In most studies, socio-economic status is considered a confounding factor in the association between education and health, based on the assumption that socio-economic status determines the level of education to a large extent. This is a justifiable approach, which evaluates the education effect conservatively. On the other hand, socio-economic status can be a consequence of education (Barrett et al., 1996).

Economic advantages are one of the most important intervening factors in the association between education and health, accounting for about half of the overall relationship between education and infant mortality (Cleland et al., 1988; Bicego et al., 1993; Barrett et al., 1996). Some economic advantages associated with education are better housing, superior water and latrine facilities, more balanced diet, more money to spend on medical care, great labour market opportunities/choices for women (jobs which may permit more time for childcare or be less exhausting) and marriage to a wealthy husband (Barrett et al., 1996).

Moreover, school attendance provides a wider social network and brings greater awareness of the outside world, with consequential behaviour effects in adult life that may positively impact one’s own health as well as childcare practices (Barrett et al., 1996; WDR, 1993). Some of the important healthy behaviours related to education are: use of health-care services; reproductive health practices; domestic hygiene practices; and domestic health care of children, among others (Barrett et al., 1996; Cleland et al., 1988; WDR, 1993).

Educated people are more likely to use modern health facilities, both for preventive and curative purposes. Most studies show a positive correlation between maternal education and use of health services such as prenatal care, delivery assistance and attendance at maternal and child health clinics (Cleland et al., 1988; Barrett et al., 1996; WDR, 1993; Ferguson, 1993; Bansal, 1999). The participation in a mass immunization campaign has a variable effect as an intervening factor in the relationship between education health in different countries (Barrett et al., 1996; Bansal, 1999; WDR, 1993; Cleland et al., 1988; Desai et al., 1998).

However, the advantage conferred by education may be greater in settings where, despite difficulties of access to health facilities, these services are available. In this case, education may provide skills and attitudes that help to overcome these difficulties (Cleland et al., 1988; Bicego et al., 1993). In countries where primary health services are weak, they will have no effect on health (Cleland et al., 1988). On the other hand, some countries, notably Cuba and Sri Lanka, have modest educational differentials in mortality. This effect seems to be based on widely available services with very good health programmes, which could partially substitute for the superior knowledge of better educated mothers (Cleland et al., 1988). But they are exceptions because educational differentials persist in most developing countries (Cleland et al., 1988).

Many authors have pointed out that reproductive behaviour changes with education. Women who have attended school enjoy several advantages, such as later marriage, delayed first birth, better child spacing, the use of family planning, and fertility decline, all of which are known to be important determinants of infant and child mortality (Barrett et al., 1996; WDR, 1993; Ferguson, 1993; Heaton et al., 1998). However, other authors conclude that the health dividend conferred by education has little to do with shifts in reproductive behaviour (Cleland et al., 1988; Bicego et al., 1993). Thus, the role of reproductive behaviour as an intervening factor between education and health remains inconclusive.

Few household studies have investigated in detail the role of domestic behaviour as an intervening factor in the association between education and health. However, there is some evidence that educated mothers and their children have better domestic hygiene, which implies more appropriate treatment and use of drinking water, better toilet practices and, where used, latrine cleanliness (Barrett et al., 1996; Cleland et al., 1988). This behaviour provides protection against infections (Cleland et al., 1988).

Education can have profound social consequences, particularly for women in male-dominated societies. Thus, school attendance may provide greater autonomy of educated mothers within the family, enlarging the sense of responsibility for and control over the welfare of children (Cleland et al., 1988).

In addition, it has been shown that educated mothers seek health attention with great timeliness, favour modern over traditional healthcare practices, are more likely to use modern drugs and therapies correctly, and face more confidently medical officials in hospitals and clinics (Barrett et al., 1996; Cleland et al., 1988). Moreover, they are able to extract a higher quality of care and adhere to advice with greater persistence, better comprehension of health messages and better retention of the information provided (Barrett et al., 1996; Cleland et al., 1988).

One study shows a small effect of maternal education on quantity of food intake or nature of diet. On the other hand, there is an almost universal trend in developing countries for less educated mothers to breast feed over longer periods of time. This might explain in part the much stronger influence of maternal education on early and later childhood than on infancy (Barrett et al., 1996; Desai et al., 1998; Bicego et al., 1993).

According to the World Development Report, 1993, well-educated mothers often manage to reduce the damage that poverty inflicts on health. Research findings indicate that child health depends more on the mother's than on the father's amount of schooling. A study in Brazil found that increased income resulting from a father's education leads to positive health benefits for children. The study also found that child health benefits from a mother's education, i.e. her increased ability to learn about positive health practices through newspapers, television, and radio.

The report also affirms that educated people tend to make choices that are better for their health. However, research work detailing the causal mechanism between education and adult health was not identified.

2. Evidence of association

Although the mechanisms of the association between education and health are not completely understood, most authors agree that a causal relationship exists (Cleland et al., 1988; WDR, 1999; Jennings, 1999). Thus, to evaluate the impact of more widespread education on health, the evidence of association will be examined, as well as the magnitude of the effect, where it exists.

Most studies on this subject evaluate the association between maternal education and childhood mortality, but there is also some evidence of the impact of education on other aspects of health.

2.1. *Association between maternal education and childhood mortality*

Most of the studies found that a higher level of maternal education was associated with a lower child mortality rate. However, this effect is more evident for early and later childhood than for infancy.

Cleland (1988), reviewing Cochrane data from 33 countries and United Nations data for 15 countries, found a linear relationship between maternal education and childhood mortality, with an average of a 7-9 per cent decline in mortality ratios for each additional year of a mother's education. The effect is similar across all regions studied.

Cleland (1988) also cites a Rutstein compilation of results from all 41 World Fertility Surveys (WFS). Examining the relative risks of death, he concludes that maternal schooling of four to six years is associated with a fall in infant mortality of about 20 per cent in sub-Saharan Africa, Arab countries and Asia, and 35 per cent in Latin America. It is also associated with declines in mortality ranging from 30 to 58 per cent in early childhood and from 43 to 72 per cent in later childhood.

A survey on Infant and Child Mortality in India (1978) and the One-in-Thousand Fertility Survey in China (1978) indicate a child mortality rate decrease of between 25 per cent and 50 per cent when comparing literate with illiterate mothers. These finding are very close to WFS estimates (Cleland et al., 1988).

More recently, Bicego and Boerma (1993) reviewed Demographic and Health Survey (DHS) data from 17 developing countries, eight in sub-Saharan Africa. The association between education and neonatal survival varied from virtually no effect to moderately strong effects. In some countries, children of uneducated women experienced a very low and insignificant risk of neonatal death when compared to those of educated mothers, suggesting some underreporting of death in the neonatal period according to education. But the findings seem to point to differential effects of education on neonatal mortality in different realities. On the other hand, post-neonatal mortality risk is roughly twice as sensitive to the effects of maternal education as neonatal risk after controlling for the economic condition of the household. Six out of 11 countries presented a significantly higher risk of post-neonatal mortality among children of women with no education when compared to those with secondary education after controlling for economic status (the risks varied between 1.5 and 11.7 per cent).

Barrett (1996), citing a Kalipeni World Bank study on health in Africa using DHS data, states that under-five mortality may be lowered by as much as 50 per cent in families where the mother has attained secondary education.

Disease-specific mortality rate is also associated with education. Investigating determinants of diarrhoea infant mortality, De Souza et al. (2001), found that female illiteracy rate was the strongest predictor of specific-specific infant mortality rates ($ß = 0.27$, $p = 0.0006$) in crude analysis, and became even more significant by adjusting for other socio-economic determinants ($ß = 0.40$, $p = 0.006$).

2.2. *Differential effect between maternal and paternal education on childhood mortality*

The World Development Report 1993 draws on three studies to demonstrate that maternal education has a greater impact on the reduction of child mortality then paternal education.

Data for 13 African countries (1975-85) shows that a 10 per cent increase in female literacy rates reduced child mortality by 10 per cent, whereas changes in male literacy had little influence. Demographic health surveys in 25 developing countries show that, all else being equal, even one to three years of maternal schooling reduce child mortality by about 15 per cent, whereas a similar level of paternal schooling achieves only a 6 per cent reduction.

The report also cites a Hobcraft (1993) study on Indonesia, Kenya, Morocco and Peru showing a higher effect of maternal education on child mortality compared to paternal education. It also shows an increase in the maternal and paternal education effect with the number of years of schooling when compared to the ones with no schooling. With the exception of Morocco, maternal schooling of four to six years was linked to a reduction in child mortality of around 35 per cent, whereas paternal child mortality reduction for the same amount of schooling was around 20 per cent. In Morocco, the reduction in child mortality for four to six years of schooling was slightly higher, but the difference between maternal and paternal education was found to be smaller (maternal schooling 45 per cent and paternal schooling 35 per cent). For individuals with seven or more years of schooling, maternal education reduced the mortality risk by around 65 per cent while paternal education reduced the mortality risk by around 55 per cent. The only exception was Kenya, where the effect of seven or more years of parental education on child mortality was smaller, but the difference between maternal and paternal education was larger (maternal schooling 38 per cent and paternal schooling 55 per cent).

Other evidence that reinforces the importance of female education is related to lower infant mortality in countries that have more equitable gender enrolment in school. According to the *World Development Report 1993*, countries that by 1965 had achieved near-universal enrolment for boys but much less for girls had about twice the infant mortality of countries with a smaller gender gap in 1985.

2.3. Association between maternal education and growth faltering

There is some evidence that better educated mothers have better nourished children. Stunting (low height for age) reflects chronic undernutrition and due to adaptation does not necessarily indicate increased susceptibility to disease and death (Bicego and Boerma, 1993). Underweight status (low weight for age) reflects acute undernutrition; it is an indicator sensitive to disease prevalence and to short-term seasonal fluctuations in food availability.

The Bicego and Boerma study shows that in 12 out of 16 countries, children of women with no education were significantly more likely to be stunted than children of women with secondary education. The risks varied from 1.2 to 2.8 per cent after controlling for economic status. The gross relationship between maternal education and underweight status is more pronounced than the education/stunting relationship, but economic status plays a major role in the underweight status/education relationship. Nevertheless, after controlling for economic status, in half of the countries studied the children of women with no education are significantly more likely to be underweight than children of women with secondary education; the risks varied from 1.4 to 3 per cent.

Another study among poor rural households in Côte d'Ivoire found that 24 per cent of the children of mothers with no education were stunted, but when mothers had some elementary schooling the prevalence of stunted children was only 11 per cent (WDR, 1993).

2.4. Association between education and healthy behaviour

There is strong evidence that educated women have healthier behaviour. Relative to the use of health services, Bicego and Boerma (1993) found, after adjustment for economic status, that women with no education have a significantly higher risk of non-use of prenatal care in all 17 countries studied when compared to those with secondary education or with any education. The risks varied from 1.8 to 14.29 per cent. In 14 out of 16 countries studied, they also found a significantly higher risk of non-use of tetanus toxoid among women with no education when compared to those with secondary education or with some form of education. The risks varied from 1.07 to 2.6 per cent.

A multivariate analysis of data from five World Fertility Surveys in Latin America found large differences in the utilization of maternal and child health services associated with maternal education, after adjustment for maternal age, parity, rural-urban residence and husband's occupation (Cleland et al., 1988). A higher percentage of mothers with six or more years of schooling receive prenatal care from a doctor or midwife, deliver in the presence of a doctor or midwife, and have their infants receiving health care or any immunization than those with zero-two years of schooling (risks between 1.16 and 2.2 per cent).

In another study in Lima, the prevalence of women with six or more years of education receiving prenatal care was 82 per cent, while among those with no education, prevalence was 62 per cent after controlling for service availability and socio-economic status (WDR, 1993).

Furthermore, a follow-up study of Filipino children found that each additional year of maternal education increases the probability of preventive health service use by 4 per cent during any month during the first year of life (Bicego et al., 1993).

Another important healthy behaviour is related to the appropriate treatment of child diseases. Several studies have shown that educated mothers are more likely to use oral rehydration therapy or a homemade solution of salt and sugar to treat childhood diarrhoea than an uneducated mother. In Thailand, mothers with primary education and with secondary or higher education were 30 and 90 per cent respectively more likely to use this treatment than mothers with no education (WDR, 1993). Similar results were reported in countries as diverse as Burundi, Colombia, Ghana, Morocco and Nigeria.

On domestic hygiene, evidence that educated people attach higher value to water supply quality was noted in Brazil, India and Nigeria, where better educated households are willing to pay 6 to 50 per cent more than other households for improved water supplies.

Even though it is not a clear intervening factor in the relationship between education and health, a study in Gambia found a statistically significant difference in birth spacing associated with maternal education. While 60 per cent of educated mothers had an average interval of more than 30 months between births, only 30 per cent of uneducated mothers reached this average (Barrett et al., 1996).

2.5. Association between education and adult health

The *World Development Report 1993* presents several studies relating higher educational levels to higher life expectancy, lower mortality rates and healthier behaviour.

A United States study shows that white men with the highest level of education have a life expectancy of about six years more at age 25 than white men with the lowest level of education. Among white women the difference is about five years. These patterns have persisted since the 1960s (WDR, 1993).

Surveys in Côte d'Ivoire, Ghana, Pakistan and Peru display the same trend, showing that respondents whose parents are educated are more likely to have living parents than those with uneducated parents (WDR, 1993). In Peru, 72 per cent of the educated fathers of respondents ages 25-29 were still alive at the time of the survey, compared with only 55 per cent of uneducated fathers.

In Russia, educational differentials were found among death rates from coronary heart disease, which is two to three times more common for the poorly educated than for those with higher education.

According to Achutti et al. (1988), the prevalence of several important risk factors was higher among illiterate adults than among those with postsecondary education. High blood pressure and obesity were five times greater among illiterate adults than among those with postsecondary education. The illiterate adults had also a significantly higher prevalence of alcohol and tobacco consumption and displayed a lack of exercise (WDR, 1993).

Apparently, educated people change their behaviour faster when risk factors are identified. The decline in smoking is an example of this pattern. In the United Kingdom between 1958 and 1975, the proportion of adult smokers declined by 50 per cent among the most educated while it hardly changed among the least educated. In the United States between 1974 and 1987, smoking declined nine times faster in the highest education group then in the lowest. The corresponding difference was twofold in Canada and threefold in Norway (WDR, 1993).

The same happened in the case of HIV/AIDS. As information about prevention became available, people with higher levels of education were the first to change their lifestyles. Although in the beginning of HIV/AIDS epidemic, individuals with high levels of education were the most affected, this trend reversed everywhere. For example, in Brazil in the early 1980s, 79 per cent of those infected had completed postsecondary education, while in the late 1980s, this group share of cases had fallen to 33 per cent (WDR, 1993).

Some of the differences found in the cited studies are probably due to differences in socio-economic status, but it can also be assumed that another important part of the effects is related to levels of education. This hypothesis is reinforced by a Jamaican study, which indicates that education has a bigger influence on adult health than income, particularly before the age of 50 (WDR, 1993).

3. Conclusion

There is strong evidence of a significant relationship between education and health. Several studies show the association between higher levels of maternal education and lower child mortality rates, as well as association between maternal education and growth faltering. Moreover, there are studies linking higher levels of education with higher life expectancy and healthier behaviour.

While some studies did not find a clear effect of education on health there is still strong evidence of its association (Desai et al., 1998). The variability in the findings is due, in part, to differences in the variables used to adjust for socio-economic factors and in the understanding of the causal net. For example, Desai et al. (1998) consider husband education as a confounding factor, but for this report it is an intervening factor within the causal net of maternal education and health. Even under the Desai study model, which gives a conservative estimate of the maternal education effect, the study found a significant impact on infant mortality and height for age for some countries. Moreover, in half of the countries studied, maternal education was significantly associated with children's immunization status, even after individual-level and community-level controls were introduced.

However, even if the education and health causal relationship appears to be well established, there are some difficulties in developing a formula to estimate the impact of more widespread education on health, given country level data. The reviewed literature reflects considerable variability in the magnitude of education effect estimates. Regarding the impact of education on child mortality rates – the subject with the greatest number of studies – the relative risk varies widely, from 15 to 72 per cent, the bulk of estimates lying between 20 and 50 per cent. Moreover, there are few studies about the impact of education on each of the other health effects, and its results are difficult to combine due to the variability in the measurement of outcomes and in the educational comparison groups. Additional difficulties are related to the fact that most of the evidence was generated by studying a single country or a group of countries in the same region, making it difficult to generalize the magnitude of the association on a global level. Another problem is to summarize the effect of education on several health outcomes. The available studies do not provide estimates of the educational impact on a synthetic indicator of health, such as DALY or its components, years of life lost (YLL) and years of life lived with disability (YLD).

Thus, the present analysis is based on data from the *World Development Report 1993*, in order to provide consistent inputs for developing a formula.

II. Estimating the relationship between education and disability adjusted life years (DALY)

1. Evidence derived from World Bank data

Prevalence ratios of the outcomes according to different levels of education, or the health benefits of each one-year increment in education are inappropriate input for developing a formula to estimate the impact of more widespread education on health. Instead, it would be necessary to measure the impact of each percentage point increase in educational enrolment on health. Furthermore, it would be desirable to have the possibility of estimating the effect on a synthetic measure of health, such as DALY. These estimates are provided by the analysis of WDR data.

2. Data analysis

The descriptive analysis examined the averages and standard deviation of each variable, as well as its distribution. Since GNP per capita does not present a normal type of distribution, a logarithmic transformation was done to include this variable in the model. Then, a crude correlation and correlation adjusted for GNP per capita were performed.

The multivariate analysis consisted of a linear regression evaluating the association of each educational variable with DALY. The crude values were examined, as well as the regression coefficient adjusting for confounding factors. The effect of primary education was adjusted for the logarithm of GNP and secondary education, while the effect of secondary education was adjusted for the logarithm of GNP and primary education.

3. Proposed formula

This report proposes a formula to estimate the impact of more widespread education on DALY, based on country level data and data by demographic region. The formula relies on the regression coefficient adjusted for confounding factors estimated for the association between net education enrolment ratio and DALY (table 12) (WDR, 1993).

The impact of an "x" per cent increase in the education enrolment on DALY is equal to an "x" per cent increase in the education enrolment multiplied by the regression coefficient for the association between the level of education in study and DALY, specific for country income level and adjusted for confounding factors (table 12).

The adjustment of the effect of one level of education to the other captures their independent effects on DALY. Thus, their combined effects would be the sum of its independent effects.

3.1. Advantages of the formula

The formula to estimate the impact of education on DALY is simple, easy to apply and requires very little data. The only necessary data to estimate the impact of an increase in education enrolment is the percentage change on education enrolment and the regression coefficients provided in table 12.

3.2. Disadvantages of the formula

Some countries reflect a relationship between education and health that is different from the majority of the countries studied. These particularities are not taken into account by the proposed formula. Generally, these occur due to different weights on the exposure factors in the causal net. This is the case, for example, for countries that have very good health services, improving health despite low levels of education. In these cases, the decrease on DALY related to the increase of education could exceed 100 per cent. One alternative for these cases could be, rather than calculating the DALY decrease using the regression coefficient, estimating the decrease in DALY from the median DALY reduction percentage (table 13).

Another problem is the fact that DALY data and part of the net enrolment ratio data were estimated indirectly in the analysis using data for each country. In the event of more precise available data for this important outcome in several countries, it would be desirable to review the regression coefficient of DALY association with education.

4. Results

4.1. Association between education and DALY, examining data for each country

Table 9 presents the average values of each variable for low-, middle- and high-income countries, as well as, for all countries, the corresponding value weighted for each country's population.

Tables 10-12 present the association between gross, net and estimated net primary and secondary education enrolment (male female and total) and DALY examining data for each country (n = 127).

The results vary according to the independent variable used, but some trends emerge. The effect of education on DALY decreases with the increase in the country income level. Each one-year increase in the education enrolment ratio decreases DALY per 1,000 population by 1.2 per cent or less. The magnitude of GER and estimated NER effect on DALY are more similar than the magnitude of NER effect on DALY.

Regarding GER and estimated NER, each one percentage point increase in male, female or total primary or secondary education in low-income countries decreases DALY per 1,000 population between 0.6 and 0.9 per cent, while among middle-income countries the decrease varies between 0.4 and 0.6 DALY per 1,000 population. The associations are significant, except for the association of secondary GER and estimated NER with DALY in low-income countries (tables 10-12). A clear gender pattern did not emerge.

4.2. Applying the formula: Impact of universal education on DALY, examining data for each country

Tables 14-25 present the DALY reduction in each country resulting from a change in net primary and secondary education enrolment (male, female and total) in 1990 to universal education (100 per cent).

Column 1 shows the countries, column 2 presents the population in each country in millions, column 3 shows the percentage of enrolled children or teens in each country in 1990, and column 4 reports DALY per 1,000 population estimated for 1990. Column 5 presents the DALY reduction per 1,000 population in the event that each country reached universal education (male, female and total, primary and secondary education enrolment). Thus, column 5 is 100 minus column 3 times the regression coefficient (table 12). Column 6 estimates the percentage of DALY reduction. It was calculated by multiplying the figure in column 5 times 100, divided by the corresponding figure in column 4.

DALY estimates for China and India were not available. To include the two most populous countries in the evaluation of impact of education on DALY, a DALY estimate was constructed in the following manner. Among several health indicators, infant mortality was selected as one highly correlated with DALY. Looking at the ten countries with infant mortality values closest to China, the average DALY of these countries was attributed to China. The same procedure was repeated to estimate India's DALY.

The total in each table took into consideration only those countries with complete data sets. The presented values are the averages weighted by each country's population (tables 14-25). Table 13 presents the mean and median of the percentage of DALY reduction by country income level non-weighted for population.

The percentage figures of DALY reduction related to the expansion of primary education enrolment to 100 per cent vary between 12 and 26 per cent, while the figures corresponding to an expansion of secondary education enrolment to 100 per cent vary between 43 and 69 per cent, but involve large standard deviations (tables 14-25). The impact of primary education expansion to 100 per cent did not exceed 100 per cent of DALY reduction in any country, but the impact of secondary education expansion to 100 per cent exceeded 100 per cent of DALY reduction in seven countries (tables 14-25).

4.3. Association between education and DALY, examining data by demographic region

Tables 26-31 present the association between education and DALY, using the data for each demographic region (n = 8). In this equation, each percentage point increase in primary education enrolment accounted for a decrease of 10.09 DALY per 1,000 population, while for secondary education enrolment the decrease was 1.04 DALY per 1,000 population (tables 26 and 27).

Regarding age groups, the main effect was on the DALY of children 0 to 5 years old, for whom the regression coefficient was 33.2 for primary education enrolment and 5.48 for secondary education enrolment (tables 26 and 27). Gender did not display a clear pattern (tables 26-31).

4.4. Applying the formula: Impact of universal education on DALY, examining data by demographic region

According to the estimates, universal primary education enrolment could reduce total DALY in the world by 51 per cent, while universal secondary education could reduce total DALY by 21 per cent. The percentage decrease in DALY is higher in the developing countries and lower in the industrialized countries (tables 32-37). In only one instance, the estimated DALY reduction percentage reached 100 per cent. It referred to the expansion of secondary education in China (table 35).

5. Discussion

A strong negative association between education and DALY was found after adjustment for confounding factors (tables 10-12 and 26-31). The literature describes a significant negative association between education and mortality rates. This outcome is related to the YLL component of DALY, which is in accordance with the findings (Cleland et al., 1988; Bicego et al., 1993). Moreover, the effect of education on DALY is greater in poorer countries (table 12). The inverse relationship between the magnitude of the effect and country income reinforce the idea, already described in some papers, that education is even more important in a context of deprivation where it helps to deal with adversities (WDR, 1993).

The greater impact of male and female primary and secondary education in the reduction of DALY among 0 to 5 years old is also in agreement with the literature, which frequently relates maternal education with the decrease in infant mortality (tables 26-31) (Cleland et al., 1988; Bicego et al., 1993).

The regression coefficients of the association between education enrolment rate and DALY are higher in the analyses by demographic region but present large standard errors. The analyses by each country, despite the indirect estimates of the exposure and outcome variables, were more precise and better captured particularities of the association between educational enrolment rate and DALY once permit to estimate the coefficient for three different levels of income.

Several countries in which the DALY reduction per cent is very far from the average, especially the ones outside the standard deviation, should be examined to understand the reasons for this behaviour. On the other hand, the formula performs well in the estimation of the impact of educational expansion on DALY in a group of countries where possible deviance from the average relationship between education and DALY is more diluted.

The validity of the study is limited mainly by its design, the quality and completeness of data, and the scarcity of the literature to compare the magnitude of the estimated effects. The ecological studies examine aggregate data, which is rather vulnerable to ecological fallacies.

The data provided by the *World Development Report 1993* comes from several sources, using direct and indirect estimates. It is a valuable source that provides a great number of variables for the world’s most populous countries, but it is important to keep in mind that there is variability in the precision of data. Moreover, the restricted data availability prevents a more complete multivariate analysis with better adjustment for socio-economic factors and better understanding of the causal net. The results presented here are preliminary and should be interpreted with a caution, but may be useful to understand the potential magnitude of burden from the lack of education.

III. Effect of worst forms of child labour on health

Chapter 3 presents the definition of worst forms of child labour, summarizes the extent of child labour, and discusses the evidence of the association between the worst forms of child labour and health outcomes.

1. Definitions

This report uses the definitions of ILO Convention No.182 on the worst forms of child labour. Thus, a child is considered a person under the age of 18, and the term "the worst forms of child labour" will comprise:

(a) all forms of slavery or practices similar to slavery, such as the sale and trafficking of children, debt bondage and serfdom and forced or compulsory labour, including forced or compulsory recruitment of children for use in armed conflict;

(b) the use, procuring or offering of a child for prostitution, for the production of pornography or for pornographic performances;

(c) the use, procuring or offering of a child for illicit activities, in particular for the production and trafficking of drugs as defined in the relevant international treaties; and

(d) work which, by its nature or the circumstances in which it is carried out, is likely to harm the health, safety or morals of children (ILC, 1999).

Convention No.182 establishes that the types of work referred to under item (d) shall be determined by national laws or regulations, or by the competent authority. This report takes into account the main types of hazardous work children are actually engaged in and the hazardous industries, occupations, activities and agents most frequently cited in national legislation on child labour (table 38).

According to Forastieri (1997), the main types of hazardous occupations are: agriculture, mining, construction, manufacturing (textile workshops, carpet weaving, garment and leather industry, ceramic and glass factory work, match and fireworks industries, slate-making, paint shops, metalwork, brick making, button making, precious stone and gem industry), abattoirs and meat processing, deep-sea diving/fishing, services sector (bakeries, grocery stores/supermarkets, car repair garages and petrol stations) and marginal productive activities (domestic service/house work, home work, toy making, scavenging in dumps/rag-picking and street work). Another important sector is retail. The number of child workers in this sector is increasing. In the United States, this industry already employs a high number of teenage workers, and accounts for one of the highest rates of non-fatal injuries, mainly in fast food and other restaurants (Committee on the Health and Safety Implications of Child Labor, 1998).

These occupations are declared prohibited for children by several national legislations, either as the occupation itself or through the prohibition of exposure to agents. Thus, this report looks into the evidence for the relationship between these occupations and effects on health (table 38).

2. Scope of child labour

The latest child labour headcount states that there are 211 million economically active children between ages 5 and 14 in the world, 98 per cent of them in developing countries. It is estimated that over half of them work in hazardous occupations (ILO, 2002).

The number of economically active children aged 15 to 17 is estimated at 141 million, with 42 per cent in hazardous work (ILO, 2002). According to the Organisation for Economic Co-operation and Development (OECD), within its member countries 26.2 per cent of the young people aged 15 to 19 are employed (Dorman, 2001). In the United States, the Current Population Survey (base monthly surveys for 1993 to 1996) indicates that about one-third of Americans aged 16 and 17 are employed at any given time during the year. According to Dorman (2001), it is likely that more than half of all teenagers below the age of 18 are in the labour force in industrialized countries.

In developing countries, data on teenagers aged 15 to 17 pointed to a prevalence of work of 47 per cent in Brazil (1989), 36 per cent in the Philippines, and 50 per cent in Ecuador (1994) (Fausto et al., 1996; ILO, Manila, 1998; Salazar et al., 1999). In Guatemala (1994), 40 per cent of the children aged 13 to 15 and 55 per cent of the adolescents aged 16-17 were working (Salazar et al., 1999).

There is a lack of global estimates on the percentage of child workers in each major industry division. However it is expected that most of the 5-14-year-old children work in agriculture, and services, while 15-17-year-olds work mainly in services, manufacturing and retail (table 39) (ILO, Statistics on Working Children, 1998; Fausto et al., 1996; Committee on Health and Safety, 1998).

Even in developed countries, there is a very high prevalence of illegal work among children and adolescents. According to United States Department of Labor estimates, there are more than 4 million children legally employed and another 1-2 million employed under illegal conditions (Landrigan et al., 1997) in the United States. The main violations in the United States were work for more hours than permitted by law or work on tasks forbidden by law. In the United Kingdom, 63-77 per cent of school-age children have already worked, while most of them are unregistered (48 per cent in Solihull, 98 per cent in the Wirral, Rochdale, Salford and Northampton and 90 per cent in Scotland, the Midlands and the North of England) (Rikowski, 1997). A study in Greenwich found that 41 per cent of children aged 10-15 had jobs, and that 78 per cent of these were illegal (Rikowski, 1997).

Studies from the United States show that illegal work may be a contributing factor for work-related morbidity and mortality (Castillo et al., 1999). It is estimated that at least 70 per cent of work-related injuries are concentrated among the approximately 1 million children who are working illegally (20 per cent of the workforce). The remaining 30 per cent of injuries occur among the 4 million children (80 per cent of the total workforce) who are employed under legal conditions. The risk of injury is therefore almost ten times greater among children who are employed under illegal conditions than among those working in compliance with the law (Landrigan et al., 1993). Moreover, the Occupational Safety and Health Administration (OSHA) fatality investigations indicate that 43 per cent of children's fatal work injuries occurred in jobs proscribed by Fair Labor Standard Division (FLSA) (Suruda et al., 1991).

There are few estimates about illegal work in developing countries, but considering data from 26 countries that conducted national surveys on child labour recently, there is evidence that a great number of children perform hazardous work. In some surveys, 37 per cent of working children aged 5-14 were found working 40 hours or more per week, and between 13 and 61 per cent did not attend school. In some locations, up to 50 per cent of working children were engaged in stressful work, up to 60 per cent came home from work exhausted, and up to 80 per cent reported having no day off or no free time (ILO, Statistics on Working Children, 1998). Recent estimates indicate that the percentage of economically active children aged 5 to 17 whose work is hazardous is 49 per cent (ILO, 2002).

Some authors state that child labour (particularly teenage labour) may have some positive outcomes, such as increased discipline, responsibility, self-confidence and independence; it teaches how to manage money, provides valuable models and teaches work skills. However, it can also have a very negative impact on children’s health. The harm will be greater the higher the interference of work with school, recreation or rest, the younger the children, the longer the number of hours of work, the more it involves night schedules, the more hazardous the nature of work and the lower the wage (Fassa et al., 2000; Castillo et al., 1999; Committee on Safety and Health, 1998).

Several activities performed by children and teenagers are not appropriate for their age, and due to their nature or circumstances, likely to harm young people’s health, safety or morals. They should be counted among the worst forms of child labour. Thus, it is important to evaluate the harm in each specific hazardous form of child labour in order to establish the priorities in the combat against the problem.

3. Available bibliography

Most of the available bibliography is from developed countries, mainly the United States. It investigates the impact of child labour on injuries, with little information on illnesses. Studies from developing countries frequently present small and/or non-randomized samples and a lack of control for confounding factors. They often focus on common morbidity using a cross-sectional design, which implies temporal ambiguity.

4. Specific hazardous forms of child labour and their health outcomes

Chapter 3 presents the evidence of hazardous exposure and its health outcomes by major industry division and by specific industry, where available. It discusses general data on injuries. More details on this subject can be found in tables 64 to 79.

5. Agriculture

Agriculture is the most common child occupation worldwide, existing in virtually all countries of the world (Fassa et al., 2000; Forastieri, 1997). In a survey conducted in 26 developing countries, 70 per cent of child workers aged 5-14 were found to be in agriculture, hunting, forestry and fishing (table 2) (ILO, Statistics on Working Children, 1998). Among the 15-17-year-olds, 12 per cent in Brazil (1988) and 8 per cent in the United States (1996) were working in agriculture (Fausto et al., 1996; Committee on Health and Safety, 1998; Tucker, 2000).

Children engage in this economic activity at a very early age, some at aged 5 or 6 years (ILO, Statistics on Working Children, 1998). In the United States, many farmworkers start working between the ages of 13 and 15 (Tucker, 2000). There is a myth that these children are performing work associated with fresh air and nature, mainly in family units, in a healthy environment, but in fact agriculture is a rather dangerous occupation (Dorman, 2001). There is an international trend towards mechanization, specialization (monoculture), and technological advances in the fields (Wilk, 1993). The number of family farms decreased significantly, and the majority of children and adolescents are hired workers or farmworkers’ children working alongside their parents

(Committee on Health and Safety, 1998). These children face numerous hazards at work. The work in agriculture is consistently ranked among the top three most hazardous industries for mortality and morbidity (Cooper et al., 1995).

5.1. Main hazards

Hazardous equipment

Farmworkers routinely use knives, hoes, and other cutting implements; they operate or work near heavy machinery (rapidly rotating equipment such as augers that move grain and power take-off shafts attached to tractors, heavy wagons, conveyor belts and others); and work on ladders (Wilk, 1993; Tucker, 2000). The exposure to hazardous equipment is the most common cause of fatal and non-fatal injuries among children in agriculture (Wilk, 1993).

Exposure to pesticides

According to Tucker (2000) children and adults working in agriculture can be exposed to pesticides in a variety of ways: working in a field where pesticides have recently been applied; breathing in pesticide “drift” from adjoining or nearby fields; working in a pesticide-treated field without appropriate protective gear, such as gloves and masks; eating with pesticide-contaminated hands; eating contaminated fruits and vegetables; and eating in a pesticide-contaminated field. Workers can also be exposed to pesticides if they drink from, wash their hands, or bathe in irrigation canals or holding ponds, where pesticides can accumulate. In some countries in Asia and Latin America, children are highly exposed while holding flags to guide planes spraying pesticides as they fly over the fields (Forastieri, 1997).

Some of these forms of exposure are exacerbated by the lack of clean water in the fields, which means workers are not able to wash off pesticide residues before eating or going to the toilet. Instead, it means that they suffer prolonged exposure to these chemicals. Moreover, the improper storage and disposal of containers might increase the possibility of exposure (Wilk, 1993; Fassa et al., 2000).

Migrant child farmworkers can suffer from increased exposure because their labour camps are often located in the fields, and their living quarters are frequently substandard, makeshift housing of cardboard, plastic or wood, that are sprayed when the fields are treated with pesticides (Wilk, 1993).

A study on Mexican-American migrant child farmworkers who worked in New York State showed that 48 per cent had worked in fields wet with pesticides and 36 per cent had been sprayed directly or indirectly by drift while working in fields or orchards (Wilk, 1993). Most of the children had no training or protective equipment to deal with pesticides. According to Human Rights Watch research, some adolescent workers did not even know what pesticides were (Forastieri, 1997; Tucker, 2000).

Among girls working as fruit growers the exposure to pesticides is frequent. Ten girls with a mean age of 13.7 (standard deviation 1.6) were examined, and their levels of acetylcholinesterase (AChE) in red blood cells, indicating exposure to organophosphate pesticides and carbamate, were determined. Four girls had AChE levels lower than the reference value, indicating a clear exposure to these agents (Harari et al., 1997). A survey of 141 farmworkers aged 14-17 in North Carolina found that 38 per cent used pesticides or farm chemicals (40 per cent males and 33 per cent females) (Schulman et al., 1997).

Little is known on the effects of pesticides on child health. Children’s organs are still growing, and their bodies might not efficiently detoxify and eliminate chemicals. They have a longer lifetime to develop health complications after exposure, and they have greater relative exposure due to their greater intake of food, water and air per body unit. Thus, there is great concern that children have a higher susceptibility to harm by pesticides than adults. (Tucker, 2000; Committee on Health and Safety, 1998; Fassa et al., 2000).

The exposure to pesticides has been associated with a number of delayed health effects, such as chronic dermatitis, fatigue, headaches, sleep disturbances, anxiety, memory problems, and different kinds of cancers, birth defects, sterility, blood disorders, and abnormalities in liver and kidney function, chronic neurotoxicity, and adverse reproductive consequences (Committee on Health and Safety, 1998).

Poor field sanitation

Frequently, fields lack clean water, hand-washing facilities, and toilets. The use of shared drinking cups is also common (Committee on Health and Safety, 1998; Tucker, 2000, Wilk, 1993; Alessi et al., 1997). The poor sanitation contributes to the spread of parasites and to the dissemination of communicable diseases (Committee on Health and Safety, 1998). The lack of hand-washing facilities contributes to pesticide poisoning (Wilk, 1993), and the lack of drinking water puts the farmworkers at risk of heat disorders (Wilk, 1993).

Unsafe transport

The transport of farmworkers is often made in overcrowded trucks and vans that have all the seats and seatbelts removed in order to pack in as many workers as possible (Wilk, 1993). In Brazil it is common to carry the workers in the open back of a truck (Alessi et al., 1997). Many times these vehicles are operated by unlicensed, uninsured, and intoxicated drivers (Wilk, 1993). Sometimes, the vehicles are in bad condition, and accidents are frequent (Alessi et al., 1997).

Excessive and inappropriate hours of work

Children work long hours in agriculture, frequently during the early morning or late evening (Wilk, 1993; Committee on Health and Safety, 1998; ILO, Statistics on Working Children, 1998; Alessi et al., 1997). Health providers have documented that children work more than 60 hours a week, some even 80 or more hours (Wilk, 1993). In the United States during the summer months, children work 20-55 hours per week (Wilk, 1993). In one major survey in a developing country, 64 per cent of child labour in the agricultural sector was found to occur during evenings or nights (ILO, Statistics on Working Children, 1998). For example, in sugar cane plantations a typical child worker’s job called “lambaio” is performed between 6 p.m. and 6 a.m. It consists of assembling the cut canes not collected by the machines, which should be done at the same speed as the machine. (Alessi et al., 1997). The intensive work and fatigue increases the risk of work-related injuries (Wilk, 1993; White et al., 2001).

Strenuous physical work

Agricultural work involves lifting heavy loads, working in awkward positions, and constantly repeating actions, which has been linked to musculoskeletal trauma (Committee on Health and Safety, 1998).

Extreme temperatures

Agricultural workers are exposed to heat. This exposure is aggravated by the long hours of work, the strenuous physical work and the lack of drinking water (Tucker, 2000; Wilk, 1993). In the sugar cane plantations, the workers drink cane juice but even if this hydrates, it can cause intestinal problems due to the high content of saccharin (Alessi et al., 1997). The heat illnesses can lead to death or brain damage (Tucker, 2000). It is important to take into account that children are more susceptible to heat stress than adults (Committee on Health and Safety, 1998).

Noise

Children and adolescents are exposed to noise while using heavy machinery. Broste et al. (1989) measured noise in 31 tractors at ear level in driver's seat, without cabs or with a cab with an open window. Only one tractor produced less than 85 dB at full throttle, and six tractors produced sound levels of 95 dB or more. This exposure may cause occupational hearing loss.

Animals

Bites of poisonous insects and snakes, and injuries incurred while attending farm animals are important causes of morbidity and mortality among agricultural child workers (Banerjee, 1995).

5.2. Main health outcomes

Work-related injuries

Although 8 per cent of child workers are in agriculture in the United States, the agricultural sector accounts for 7 per cent of non-fatal injuries and 40 per cent of fatal injuries (Committee on Health and Safety, 1998; Layne et al., 1994; Derstine, 1996; Tucker, 2000).

Most studies see agriculture in second place in terms of fatal injury rates. The adult rates presented vary from 18 per 100,000 FTE workers to 61 per 100,000 workers (tables 26 and 28, Chapter IV). Fatal injury rates among farm children were calculated to be 13.7/100,000 among 10-14-year-olds and 16.8/100,000 among 15-19-year-olds (tables 69 and 71, Chapter IV).

More than half of young people's work-related fatalities occurred on family farms. Agricultural machinery accounted for 68 per cent of the machine-related on-the-job deaths among adolescents (Castillo et al., 1994). Several studies pointed to tractors as the main cause of machine-related deaths (around 50 per cent) followed by farm wagons, combines and forklifts (Castillo et al., 1994; Landrigan et al., 1995; Landrigan et al., 1992; Pollack et al., 1990; Mandryk et al., 1995). Of the 50 tractor-related deaths identified in Castillo et al. (1994) study, at least 29 were caused by rollovers and four were a result of an individual being run over. Power take-offs contributed to at least three of the deaths. The violation of the Fair Labor Standards Act occurred in 86 per cent of the fatalities (Dunn et al., 1993).

The non-fatal injury rates in the United States vary from 0.46 per 100 workers to 8.4 per 100 FTE workers with a median of 1.5 per 100 FTE workers in studies using data from workers' compensation claims and from emergency department rooms (Belville et al., 1993; Schober et al., 1988; Layne et al., 1994).

Considering permanent disability as an indicator of injury severity, agriculture is associated with the most severe injuries. The permanent disability rates exceeded the temporary disability rates by a ratio of 1.17 (Belville et al., 1993). The main nature of injuries also indicates severity with a high prevalence of fractures (Layne et al., 1994).

Farm work injuries account for only 8 per cent of all claims made. However, an important number of them are severe and occur in child workers (Heyer et al., 1992). Thus, child farmworkers made up 36 per cent of claims filed by children aged under 14, and 17 per cent of claims filed by children aged 14 and 15. Injury classified as serious accounted for 26 per cent of farmworkers' claims compared with only 16 per cent of all claims filed by children. Among workers aged 13 or younger, farmwork accounted for 50 per cent of all severe injury claims and 48 per cent of all disabling injury claims. Among workers aged 14 and 15, farmworkers accounted for 39 per cent of severe and 29 per cent of disabling injury claims.

Pesticide poisoning

Estimates of pesticide poisoning among child farmworkers are not available, but estimates for all ages indicate the importance of the problem. There is a belief that in developed nations acute pesticide poisoning is a rare event. For example, no fatalities were reported in the United Kingdom in 1979 and only 34 deaths occurred in the United States in 1977. However, more recent data from the United States Environment Protection Agency (EPA) indicates that as many as 300,000 farmworkers suffer pesticide poisoning each year, while the Natural Resources Defense Council estimates that as many as 40,000 physician-diagnosed poisonings occur each year. But only a small percentage of pesticide-related illnesses are reported to the Government or health officials (Tucker, 2000).

In 1972, the WHO estimated that about 500,000 cases of acute poisoning occur annually, resulting in over 9,000 deaths in the world. Although it is estimated that the developing countries account for only 20 per cent of the world's agrochemical sales, only 1 per cent of these deaths occurred in industrialized countries (Jeyaratnam, 1985).

Studies in the 1980s in Sri Lanka (a country with a population of around 14.5 million), found that approximately 13,000 patients were admitted each year to government hospitals for treatment of acute pesticide poisoning resulting in approximately 1,000 deaths (Jeyaratnam, 1985). If one extrapolates from prevalence in Sri Lanka, this would mean 2.9 million cases of acute pesticide poisoning in developing countries resulting in nearly 220,000 deaths (Jeyaratnam, 1985). There is a need to determine how many children and youths are among these victims (Reijula et al., 1996).

Heat illness

Heat-induced disorders are found among agricultural child labourers, particularly in tropical countries where the climatological thermal load is considerable and adds to the metabolic heat load resultant from the strenuous agricultural operations (Banerjee, 1995).

No estimate was found on the prevalence of heat illness among child farmworkers, but EPA and OSHA estimate approximately 500 deaths annually from heat illness among workers of all ages in the United States (Tucker, 2000).

Parasitic and other infectious diseases

There are little evidence of parasitic and other infectious diseases among child farmworkers, but the exposure to poor field sanitation in many places suggests that this is a problem. A study of migrant farmworkers (adults and children) in the United States shows rates of parasitic infection ranging from 20 to 78 per cent, while the prevalence among the general United States population is only 3 per cent (Wilk, 1993).

Hearing loss

One study examining occupational hearing loss among adolescent farmworkers was found. According to Broste (1989), teenage school children that are actively involved in farm work have increased prevalence of mild hearing loss and early noise-induced hearing loss.

The prevalence of noise-induced hearing loss, in either or both ears, among those who live and work on the farm is 57.1 per cent, among those who work on the farm and live elsewhere 54.5 per cent, among those who live on the farm and do not work 24 per cent, and among those who have little or no farm exposure it is 33.3 per cent. Those who live and work on the farm and those who work on the farm and live elsewhere have more than twice the risk of those who live on farms and do not work and those who have little or no farm exposure of having noise-induced hearing loss after adjustment for the effects of age, sex, family history of hearing loss, and use of amplified music, snowmobiles or motorcycles, and the difference is significant.

Respiratory problems

A study in Finland from 1986 to 1993 found that the proportion of occupational asthma (all ages) was 4.8 per cent of all new cases of asthma, 3.9 per cent among women and 6 per cent among men. More than half of the new cases of occupational asthma were found in farming populations and in bakeries (Reijula et al., 1996).

Others

Despite theoretical concern of an increased risk of musculoskeletal problems, depression, substance abuse and sexual harassment, no direct evidence has been found in the literature (Tucker, 2000, Forastieri, 1997).

6. Mining

In a survey conducted in 26 developing countries it was found that 0.9 per cent of the child workers aged 5-14 years are in mining. 15.9 per cent of them reported injuries or illnesses (table 39) (ILO, Statistics on Working Children, 1998). Estimates on the amount of adolescents working in mines were not found. Most of the children work in small-scale mines in Africa, Latin America and Central Europe; 20 per cent of them are working illegally (Forastieri, 1997). In Peru, 64 per cent of the gold production between 1991 and 1997 was informal (Jennings, 1999).

The working conditions and health and safety risks affecting children in small-scale mining differ widely according to whether work is underground or on the surface, the type of mineral being mined, and the type of processing carried out, as well as children's involvement (Jennings, 1999). But, in general, the work conditions are very hard, with children working long hours performing heavy and risky tasks.

However, the situation is even more difficult when children are employed separately from their parents, often going away from home to work. In this case, they work not just in mines but also sleep in them. On many occasions, the wage advantage is diminished by expenses on food, tools and sometimes medication, making it difficult for them to go back home, which frequently results in bonded labour. Among the considerable number of girls involved in several aspects of small-scale mining, the situation is aggravated by their vulnerability to abuse and sexual exploitation.

6.1. Main hazards

Exposure to dust – Saturated air

A study in an underground gold mine in Sibutad, Philippines found that the dust threshold limit values (TLV) for both breathable and total dust concentration of 5.0 mg/m^3 were exceeded at the tunnel entrance and at the ball mills. Lead samples in the air were also collected, both at the tunnel entrance and at the ball mills. The TLV (0.15 mg/m^3) was exceeded at both sites by about four times (0.50 mg/m^3 at the tunnel entrance and 0.66 mg/m^3 at the ball-mills).

Exposure to mercury

The exposure to mercury occurs in three situations in gold mines: during gold washing in the contaminated river, in making the amalgam, and during the heating process (Harari et al., 1997; Camara et al., 1996).

A study in an underground gold mine in Sibutad, Philippines found that ambient mercury levels at the tunnel entrance and at the ball mills exceeded the TLV of the occupational safety and health standards (0.05 mg/m^3) and more so that of the stricter American Conference of Governmental Industrial Hygienists (0.01 mg/m^3) (Jennings, 1999).

Poor field sanitation

In a survey at the gold mine in Madre Dios, Peru, most concessions were lacking facilities for clean drinking water, drainage or hygiene. The absence of sanitation resulted in a proliferation of mosquitoes (related with malaria) and other carriers of disease. Moreover the workers drank water direct from the river without first making it safe (Bequele et al., 1988).

Strenuous physical work

The excessive load the workers were expected to carry was the most common complaint among the 23 surveyed child workers of a gold mine in Madre Dios, Peru (Bequele et al., 1988).

The child workers dig, crush, grind and/or transport sacks weighing 10-25 kg (Jennings, 1999).

Noise

Evaluations of the child workers' exposure to noise in mines were not found, but it is reasonable to assume that they should be exposed to extreme noise in digging and placing explosives.

6.2. Main health outcomes

Most of the studies presented are surveys that estimate prevalence of the health outcomes, although they do not have a comparison group to better estimate the amount of disease attributable to work.

Work-related injuries

In the reviewed studies, mines present the highest work-related fatality rates (all ages), between 32 and 43 per 100,000 workers (tables 66 and 68 – Chapter IV) (Kisner et al., 1994; Bell et al., 1990; Wilk, 1993). Estimates for child workers' fatality rates were not found, but according to Schapira et al. (1999), small-scale mines have mortality rates 90 per cent higher than the mines of industrialized countries.

According to Schober et al. (1998), 8.2 per 100 FTE male workers aged 16 and 17 years suffer non-fatal work-related injuries in United States mines, while the rate for females is 5.5 per 100 FTE workers (tables 69 and 72).

The data for small-scale mines shows a 10 per cent injury rate per year in a sample of 70 child workers of a mine in Niger (Jennings, 1999). Another survey in a gold mine in Mollehuaca, Peru, which employs 885 workers, identified 18 deaths (all ages) in the 12 months prior to a census (1996-97). Accidents were the main cause of death with 28 per cent of the cases. Among 23 gold mine workers, one 12-year-old and the others aged 15-18 years in Madre Dios, Peru, over a quarter suffered accidents at work. Most of these occurred in the area where the gold is washed.

Respiratory problems

Underground mines Particularly present an increased risk of silicosis and anthracosis resulting from the long-term inhalation of air saturated with dust (Schapira, 1999). These diseases are chronic and can kill a worker in 10-15 years' time. The prevalence among workers that have been working in the mines since their childhood and its specific latency period and duration has not yet been evaluated.

In the gold mine survey in Mollehuaca, Peru, respiratory problems including tuberculosis, share first place with accidents in the causes of death (all ages). Tuberculosis was the cause in 11 per cent of the 18 deaths which occurred in a one-year period, while other respiratory problems account for 17 per cent of the deaths (Jennings, 1999). A prevalence of 2.1 per cent of tuberculosis was identified, as the third cause of illness.

A study among 14 child workers of an underground gold mine in Sibutad, Philippines found that 11 children reported respiratory problems in the six months before the evaluation.

Mercury intoxication

A study in Ecuador evaluated mercury levels in child gold mine workers. Urine samples were collected from ten children (five boys and five girls, mean age 12.1). Seven children had been working at the river for two years or more whereas three children started working in the same year. Urinary mercury exceeded 25 mg/dl in six out of the seven individuals with a longer duration of exposure (Harari et al., 1997).

In a survey in the Mollehuaca gold mine, 55 children aged 7-17-years were examined. Although they were not directly exposed to mercury at work, all of them showed evidence of mercury in the blood and hair (Jennings, 1999).

Infectious diseases

In the gold mine survey in Mollehuaca, gastrointestinal problems were in second place in the causes of death (all ages). 17 per cent of the 18 deaths occurred within a one-year period (Jennings, 1999).

The most frequent illnesses (all ages) found in the gold mine survey in Mollehuaca, Peru were cough/flu (60.6 per cent) followed by diarrhoea/cholera (8.6 per cent) (Jennings, 1999).

Among 23 gold mine workers (one 12-year-old and the others aged 15-18-years) of Madre Dios, Peru, seven suffered from malaria, six from fever and colds, and two from piodermis. So few claimed to have suffered from piodermis possibly because it is so common that it is considered part of normal life in the jungle, and so it is not seen as resulting from the conditions of work (Bequele et al., 1988). Stomach diseases (diarrhoea and colitis, caused by the quinine used for curing malaria and parasites) are generalized, although the survey did not reveal their incidence.

Musculoskeletal problems

A study among 14 child workers of the underground gold mine in Sibutad, Philippines found that 21 per cent of the children reported muscle pain as well as joint and muscle stiffness in the six months before the evaluation. Moreover, the studied children also reported back pains (14 per cent) and muscle weakness (7 per cent) in the studied period (Jennings, 1999).

Skin disorders

A study among 14 child workers of the underground gold mine in Sibutad, Philippines found that 14 per cent of the children reported skin lesions in the six months before the evaluation (Jennings, 1999).

Occupational hearing loss

Estimates of the occupational hearing loss among mine child workers were not found.

Others

Among children 7-12-year-olds working in the gold mine in Mollehuaca, 66 per cent had an intellectual capacity considered below average, while the prevalence for the 13-17-year-olds was 77 per cent. Among children aged 13-17 years, 13 per cent exhibited short-term memory deficiency (Jennings, 1999).

7. Construction

In a survey conducted in 26 developing countries, 1.9 per cent of the child workers aged 5-14 years were found to work in construction, and 25.6 per cent of them reported injuries or illnesses (table 39) (ILO, Statistics on Working Children, 1998). The percentage of adolescent workers engaged in this type of job is probably higher than among young children (Fausto et al., 1996; Committee on Health and Safety, 1998). An important number of these children are working for contractors and some in family business (Windao et al., 1999).

7.1. Main hazards

Hazardous machinery and environment

The workers in construction perform their job in high places, exposed to contact with power lines and using dangerous machinery (Ore et al., 1980; Windao et al., 1999).

Others

The workers carry heavy loads and are exposed to noise, but estimates of these workloads among child workers were not found. Construction workers are also exposed to asbestos, lead, cement, solvents and other chemical substances (Burkhart et al., 1993; Forastieri, 1997).

7.2. Main health outcomes

Work-related injuries

According to Kisner and Fosbroke (1994), the fatality rate among construction workers aged 16-19 years in the United States is 15 per 100,000 FTE workers (tables 66 and 68). Construction accounts for 13 per cent of all fatalities in children aged below 18 (Windao et al., 1999). The majority of the victims were construction labourers, particularly in special trades, and contractors engaged in such activities as roofing and concrete work (Windao et al., 1999).

Falls (23 per cent) and electrocutions (21 per cent) were leading causes of death for young construction workers, followed by motor vehicle and machinery (Windao et al., 1999; Burkhart et al., 1993). In three-quarters of the fatal falls, the youths fell from or through roofs and skylights (Windao et al., 1999). Half of the electrocutions among young construction workers resulted from contact with overhead power lines (Windao et al., 1999). Two-thirds of the victims were 17-year-olds, and 13 per cent were 15-year-olds or younger. Among the victims, 28 per cent worked for themselves or for family business (Windao et al., 1999).

In several studies, using data from workers' compensation claims and emergency department rooms, the non-fatal injury rates vary from 0.33 to 25.7 per 100 workers (tables 62 and 73).

Musculoskeletal problems

The study by Fassa et al. (2002) shows that, compared with the other major industry divisions, the construction workers aged 10-17-years had the third highest prevalence of musculoskeletal pain in any site in the year before the interview (74.1 per cent), and of back pain (44.8 per cent) in the same period. They also had the highest prevalence of pain in the elbow (6.9 per cent) and in the lower back (17.2 per cent). However, a significant increased risk of musculoskeletal problems among construction workers aged 10-17 years when compared with non-workers and workers of other industries was not identified. The lack of significance might be due to lack of statistical power because there were just 53 workers in construction. The risk of pain in any site in the year before the interview were 40 per cent higher for construction workers than for non-workers (Fassa et al., 2002).

Others

Estimates of the prevalence of dermatitis, acute lead poisoning and occupational hearing loss among child construction workers were not made. The same is true for estimates of the prevalence, latency period and duration of chronic diseases such as respiratory problems (asbestosis, silicosis, chronic obstructive pulmonary disease) and cancer in workers who started to work in construction in their childhood or adolescence (Burkhart et al., 1993; Forastieri, 1997).

8. Manufacturing

In a survey conducted in 26 developing countries, 8.3 per cent of the child workers aged 5-14 years were found to be in manufacturing, and 9.3 per cent of them reported injuries or illnesses (table 39) (ILO, Statistics on Working Children, 1998). The types of industry vary widely from country to country (Fassa et al., 2000). Most children work in small workshops or in home-based work, but medium-sized or large enterprises sometimes use child labour indirectly by subcontracting out certain production tasks (Fassa et al., 2000; Bureau of International Labor Affairs, 1998). In some countries, specific manufacturing industries (carpet weaving, match factories, glass factories and brick making) concentrate an important amount of bonded labour.

8.1. Main hazards

The manufacturing industry has hazards linked to production processes that are specific to the tasks performed. Some common hazards are exposure to dangerous machinery, exposure to noise, exposure to chemical substances, an awkward posture, repetitive movements, and heavy loads, among others.

On the other hand, there are some general hazards that arise not from the production process but from negligent management. Examples of these problems are naked electric wires, lack of first aid facilities, poor ventilation, lack of sanitation, lack of sufficient light and the lack of protective equipment. In some cases, physical punishments are frequent (Bureau of International Labor Affairs, 1998; Bequele et al., 1995).

8.2. Main health outcomes

Work-related injuries

Manufacturing is one of the major industry divisions with low rates of fatal injuries (all ages) in the United States, with around four per 100,000 FTE workers (tables 66 and 68) (Kisner et al., 1994; Bell et al., 1990). In several studies, using data from workers' compensation claims and emergency department rooms, the non-fatal injury rates vary from 0.49 to 14.8 per 100 workers (tables 69 and 74).

However, considering permanent disability as an indicator of injury severity, manufacturing had the second most severe injury rate in New York state (Belville et al., 1993). The permanent disability rates exceeded the temporary disability rates by a ratio of 1.07 (Belville et al., 1993).

In addition, manufacturing accounted for 18 per cent (second place) of the 22 amputations in a period of four years in Washington state (Miller et al., 1988). The Bureau of Labor Statistics (BLS) study indicated that, in the United States, power presses were the source of 10 per cent of the amputations (all ages). In the youngest age group (18 or younger) the press operator is five times more likely to experience an amputation than the average press operator in the studied population is. The risk decrease with age being 2.6 for 19-year-olds, 2.3 for 20-year-olds, 1.7 for 21-year-olds and 1.6 for 22-year-olds, but after the age of 23 years there is no pattern (Jensen, 1988).

Musculoskeletal problems

The study by Fassa et al. (2002) shows that, compared with the other major industry divisions, manufacturing workers aged 10-17 years had the highest prevalence of musculoskeletal pain in any site in the year before the interview (90.5 per cent), and of back pain (71.4 per cent) in the same period. There was a significant increased risk of musculoskeletal pain in any site and pain in the back in the year before the interview among workers in manufacturing when compared with non-workers (adjusted odds ratio respectively 4.7 and 3.3). They also reported the highest prevalence of pain in the neck, shoulder, wrist/hands, upper back and thigh.

Others

Studies describing the prevalence of occupational hearing loss, tenossinovitis or acute chemical poisoning on manufacturing child workers have not been found. The same goes for studies about the prevalence, latency period and duration of chronic diseases as respiratory problems (asbestosis, byssinosis, tuberculosis) and cancer in workers that start to work in manufacturing in their childhood or adolescence (Forastieri, 1997).

9. Evidence of the association between the work in specific industries and health

Textile workshops

In textile workshops, children frequently work long hours. They are exposed to old machines and risk of serious accidents, including amputations and death, and they are exposed to loud noise. They also lift and carry heavy loads, which could result in musculoskeletal problems. They are in contact with airborne dusts of cotton, flax, soft hemp and other fibres that could cause respiratory diseases such as byssinosis and asbestosis. Moreover, they are exposed to chemicals which might have a severe impact on their health: dyestuff that can cause bladder cancer; sodium, bichromate and potassium that can cause chrome poisoning or chrome eczema; solvents used in the finishing process that can cause dermatitis, and chemical poisoning (Forastieri, 1997; Banerjee, 1990; Laskar, 1996; Banerjee, 1995).

A study in South Korea found a prevalence of 4.4 per cent of hearing loss in textiles workers, which is higher than among electronic and footwear industry workers. The presence of high levels of noise was confirmed by an occupational environment assessment (Ahmed, 1991). The textile workers also reported high prevalence of tuberculosis, dyspnea, headache, muscular pain, anorexia and dizziness when compared to a control group.

Carpet weaving

Children often start working in carpet weaving at an early age. They work for long hours with short breaks in places that frequently lack adequate ventilation and illumination. They work in awkward postures doing repetitive movements. Furthermore, they are exposed to dyes and fibre dust. These hazards place them at risk of visual strain, musculoskeletal problems, chemical intoxication and cancer, respiratory problems such as asthma, tuberculosis and other respiratory infections (Forastieri, 1997). Some children in this industry are in bondage, and cases of physical and sexual abuse have been reported (Forastieri, 1997; Ahmed, 1991).

Mattoo's (1986) study in a rural area of Kashmir found that headache, blurring of vision, backache, abdominal pains, limb pains, and respiratory tract infection were several times more prevalent in carpet weaving workers than in a student comparison group and were positively associated with the duration of exposure (Laskar, 1996). The prevalence of defects of vision among carpet weaving workers was 9 per cent, while among school children it was 4 per cent (Laskar, 1996). These findings are in accordance with a study in Jaipur city (India) where headache (34.2 per cent), backache (18.2 per cent) lower limb pains (15.5 per cent) and acute respiratory infections (26.4 per cent) were present in a significantly larger number of weaving children than in the control group (Joshi et al., 1994). It is also in accordance with the study of Mirzapur city (India) (Das et al., 1992).

Joshi et al. (1994) report that the high prevalence of acute respiratory infections should be viewed with alarm because it might be the initial manifestation of chronic bronchitis or byssinosis. In this study, children with features suggestive of byssinosis were not identified. The average duration of exposure was 3.4 years, and according to Gupta the minimum duration of exposure to cotton dust required to cause byssinosis is approximately seven years (Joshi et al., 1994).

Concerning sexual abuse, it is important to cite a study in the Lahore area in Pakistan. This study interviewed 360 children younger than 14 years in nine different types of occupations. Among these children, 14 cases of sexual abuse were reported, two of which in the carpet weaving industry (Ahmed, 1991).

Garment and leather industry

According to Clark et al. (1996), the consolidation of the United States retail industry into a few huge conglomerates made these giants seek competitive advantages by outsourcing, or subcontracting to low-paying suppliers around the world. The United States garment industry's threats to send work overseas brought down wages while easing the way for sweatshop operators to take advantage of illegal immigrants desperate to work. A 1994 study by the General Accounting Office found that 2,000 of the 6,000 garment shops in New York City and 4,500 out of 5,000 in Los Angeles could be called sweatshops.

Fire, electrocution, and injuries from machines are all known risks associated with this work. The prolonged sitting, sometimes cross-legged on the floor leaning forward, chemical exposure to dyes and formaldehyde and solvent exposure in leather shops are also hazards (Pollack et al., 1990).

A study in Massachusetts, USA, found that the apparel industry presented an injury rate of 5.4 per 100 FTE workers, being the highest among the different types of industry (Brooks et al., 1996)

Mitra et al. (1993) found that 30 per cent of the working children reported symptoms related to the skeletal system such as low back pain, pain in ankles, pain and tenderness over the lower thoracic vertebrae, etc., a prevalence significantly higher than among the control group. These problems are probably related to the typical posture of these child workers.

They also found that 40 per cent of the child workers reported dizziness, and 25 per cent presented tingling sensations in fingers and palms, especially in the evening. This prevalence is significantly higher than among the control group where the prevalence was 10 per cent and zero, respectively. These neurological affections might be related to the exposure to cheap glue that contains some preservatives that are known to be neurotoxic (sodium pentachlorophenate, p-chloro-m-cresol). Moreover, glue solvents share common metabolites which are neurotoxic (n-hexane and methyl butyl ketone) (Mitra, 1993). The exposure to dyes and formaldehyde could be related to asthma, but studies on this health effect among garment industry workers were not found (Pollack et al., 1990; Landrigan et al., 1997).

Ceramic, pottery and glass factory work

The main hazards in this industry are heat, noise, chemical fumes and dust.

There are several studies pointing to a prevalence of tuberculosis and silicosis in Indian potteries of 15 per cent (all ages) (Saiyed et al., 1995; Parker, 1997). The mean duration of the exposure prior to the diagnosis of silicosis for individuals in this industry may be only 20 years compared to more than 30 years for an iron moulder (Parker, 1997).

The overall prevalence of tuberculosis in the pottery industry in India was reported to be at least ten times greater than for India's general population.

A study in Ecuador found childhood lead intoxication associated with the manufacture of roof tiles and ceramics. In that study, in all ten children examined, blood levels exceeded 20 mg/dl, and the seven children with the longest exposure duration in the moulding and glazing of roof tiles or ceramic artefacts all had values exceeding 60 mg/dl (Harari et al., 1997).

Another study in Ferozabad, India examined the cardio-respiratory responses of children exposed to a hot environment in the glass bangle industry and compared them with a control group. The results suggest a physiological strain induced by the high temperature and radiant heat prevailing in the glass bangle factory (Rastogi, 1989).

Due to the indisputable hazards present in this industry it is possible to say that accidents, particularly burns, occupational hearing loss and eyestrain should be important problems among these workers. Yet, no studies examining the prevalence of these problems and its association with ceramic, pottery and glass factory work were found.

Match and fireworks industries

Child workers are exposed to chemicals (potassium chlorate and antimony trisulphide among others), mineral and asbestos dust, poor ventilation and overcrowding. Thus, they presumably have a high risk of respiratory disease, poisoning and dermatitis, and risk of burns or even death from fire or explosion. However, studies on the health of child workers working with matches and fireworks were not found (Forastieri, 1997; Banerjee, 1990; Bihari, 1992).

Slate-making

Slate-making workers are exposed mainly to silica dust but also to noise and strenuous work (Banerjee, 1995; Forastieri, 1997; Parker, 1997).

The prevalence of silicosis in India is 35 per cent among stone cutters and 55 per cent among slate workers (all ages) (Parker, 1997). Among granite crushing workers (all ages) the prevalence of silicosis can reach 75 per cent, and because of high levels of dust exposure, these workers may have a mean latency period of less than ten years before the onset of silicosis. Tuberculosis is very common among individuals with silicosis. According to Gurndorfer and Raber, 39 per cent among 18 cases of silicosis had silicotuberculosis (Parker, 1997).

Studies examining musculoskeletal problems and occupational hearing loss among slate-making child workers were not found.

Paint shops

Paint shop workers are exposed to several chemicals such as organic solvents, as well as to asbestos, silica and lead. They are also exposed to work in awkward postures (Forastieri, 1997).

The chemicals can damage the central nervous system, cause liver injury, allergies, reproductive impairment and lung cancer. The organic solvents can have allergenic, mutagenic, teratogenic and carcinogenic effects. Long hours of work in awkward postures can lead to musculoskeletal problems (Forastieri, 1997).

Among adult painters, mortality and incidence of lung cancer are significantly higher than among other working populations (Forastieri, 1997). No studies on these problems among child painters were found.

Metal work

The main hazards faced by children doing metal work are exposure to extreme heat, flying sparks and hot metal objects; exposure to lead, iron, aluminium, nickel or chromium; and exposure to airborne carbon monoxide and carbon dioxide, smoke and other irritants (Forastieri, 1997; Bihari et al., 1992).

Symptoms of acute intoxication are alike to those of food poisoning with nausea, vomiting, abdominal pain and in some cases diarrhoea. Chronic poisoning can cause severe damage to the respiratory tract with bronchitis, chemical pneumonitis and in severe cases pulmonary oedema, renal toxicity and neurological impairment (Forastieri, 1997).

In Bihari's (1992) study of 57 brassware workers aged 10-16 years and 29 controls, the respiratory morbidity was significantly higher among those employed in the main units than among the controls employed in ancillary units (10.3 per cent versus 27.6 per cent; $p < 0.05$). The main causes of respiratory morbidity in the main units were chronic bronchitis (10.6 per cent) and lower respiratory infections (8.7 per cent). No significant differences in respect of morbidity of other systems were found between the ones employed in the main unit and those in the ancillary units (Bihari et al., 1992). The author also cites other Indian authors reporting that the prevalence of silicosis among foundry workers is 9.7 per cent (all ages).

No studies on the prevalence of chemical intoxication and injuries and its association with the metal work were found.

Brick making

The main hazards in brick making are exposure to silica, carrying excessive weights, burns from ovens, lead exposure from glaze, thermal stress due to excessive heat from ovens, carbon monoxide exposure from kilns and dangerous tools. These hazards could cause silicosis and other respiratory problems, musculoskeletal problems, intoxication and occupational injuries (Forastieri, 1997). Studies about the impact of brick making on the health of child workers were not found.

Button making

The main hazards in button making are dangerous machinery, dust exposure, chemical exposure (plastic materials, benzene, carbon tetrachloride, pigment dye), noise, vibration, poor lighting and excessive heat. These hazards can lead to injuries, intoxication, occupational hearing loss, tenossinovitis and ocular fatigue. However, studies about the impact of button making on the health of child workers were not found.

Precious stone and gem industry

The main hazards in the precious stone and gem industry are poor lighting, bad sitting postures and exposure to oxides that can lead to eye strain, musculoskeletal disorders and poisoning or dermatitis (Forastieri, 1997). However, studies about the impact of this activity on the health of child workers were not found.

Abattoirs and meat processing

The main hazards in abattoirs and meat processing are sharp blades, exposure to repetitive movements, heavy weights and extreme temperatures, as well as exposure to biological hazards due to manipulation of sick animals. These hazards can cause injuries, musculoskeletal problems, particularly repetitive strain injuries, respiratory diseases and other infectious diseases (Forastieri, 1997).

There is evidence of a high risk of accidents. Case reports of adolescent workers in a butcher's shop state a high level of amputation of arms due to an unguarded power driven band saw (Landrigan et al., 1997). Parker et al. (1994) report that butchering had the highest prevalence of striking or being struck by objects (15 per cent), in the other activities the prevalence was 4.6 per cent (Parker et al., 1994).

Deep-sea diving/fishing

Children, mainly 10-15-year-olds, dive to reset nets several times a day and can be in the water for up to 12 hours. The main hazards in deep-sea diving and fishing are quick decompression, hypoxia, exposure to predatory fish (needlefish, sharks, etc.), as well as exposure to communicable diseases due to the confinement on board the vessels. The main health outcomes would be injuries and death, ruptured eardrums and infectious diseases (Forastieri, 1997; Rialp, 1993).

It is estimated that each year four to five divers drown each season in Philippines, but no epidemiological studies about the impact of this occupation on health were encountered (Rialp, 1993).

10. Services

In a survey conducted in 26 developing countries it was found that 10.3 per cent of the child workers aged 5 to 14 are in services and transport, and 10.8 per cent of them reported injuries or illnesses (table 39) (ILO, Statistics on Working Children, 1998). In developing countries, domestic service is very common. According to Fassa et al. (2000), half of the children working in services in Pelotas, Brazil, are engaged in domestic service. In Pelotas, 80 per cent of the domestic workers between aged 6 and 17 are informal workers. Whereas in some countries it is common to find bonded children in this occupation, in Brazil at least it is one of the few types of job where the work relationship is becoming more formal. In the United States, the main occupations are in recreation, health services, educational services, or in private households (Windao et al., 1999; Belville et al., 1993).

10.1. Main hazards

Children working in services often work for long hours. Many tasks involve heavy loads, and in several places they have no sanitary facilities or rest areas (Forastieri, 1997). In some types of services the child workers stay during the night, as hotels or domestic services, being at risk of sexual abuse by employers, customers or co-workers (Laskar, 1996; UNICEF, 1999; Banerjee, 1995, 1990).

10.2 Main health outcomes

Work-related injuries

Services are among the major industry divisions with low rates of fatal injuries (all ages) in the United States, around three per 100,000 FTE workers (tables 66 and 68 – Chapter IV) (Kisner et al., 1994; Bell et al., 1990). In the United States, the main events or exposures that cause fatalities (n = 32) are transport (41 per cent), homicides (25 per cent), and exposure to harmful environment (19 per cent). Young men account for three-quarters of the fatalities. Among the fatalities, 9 per cent were unpaid workers in family business and in nearly one-fifth of the youth fatalities the victims were under the age of 15 (Windao et al., 1999).

In several studies in the United States, using data from workers' compensation claims and emergency department rooms, the non-fatal injury rates vary from 0.16 to 14.6 per 100 workers (tables 69 and 75 – Chapter IV) (Belville et al., 1993; Schober et al., 1988; Layne et al., 1994). In the Parker et al. (1994) study it was found that most back injuries occurred in janitorial work (48 per cent) and nursing work (21 per cent). Back injury was positively associated with the weights lifted at work (Banerjee, 1995). Bruises and contusions were associated with two jobs, namely bagger and stock clerk.

Musculoskeletal problems

Service workers present high prevalence of sprain or strain that is related to some typical tasks such as lifting or otherwise assisting patients in hospitals and nursing homes (Windao et al., 1999).

Others

Evidence on the prevalence of fatigue and stress that could be related with long hours of work was not found. Neither were the health outcomes resultant from sexual abuse such as emotional distress, sexually transmitted diseases (including HIV/AIDS) and unwanted pregnancy.

11. Evidence of the association between the work in specific services and health

Domestic service

Child domestic workers frequently work long hours, more than ten a day. In the Pelotas survey, almost 50 per cent of the child domestic workers perform shifts of 40 hours or more (Fassa et al., 2000). Some domestic activities such as cooking, chopping vegetables, using chemical cleaning fluids and carrying heavy items could lead to injuries, particularly when the worker is exhausted, dermatitis and musculoskeletal problems. Moreover, in some cases these workers suffer physical, emotional and sexual abuse (UNICEF, 1999; Fassa et al., 2000). The live-in workers are in greater dangerous of exploitation; sometimes they stay on call day and night and are more vulnerable to all types of abuse (UNICEF, 1999).

According to a health worker at the Maurice Sixto Shelter for child domestic workers in Port-au-Prince, Haiti, 80 per cent of the children she meets suffer stomach upsets and headaches from emotional distress (UNICEF, 1999).

In the Fassa et al. (2002) study among children aged 6 to 17 years, 79 per cent of the domestic workers suffered musculoskeletal pain at any site in the year before the interview, presenting a significantly higher risk for this problem when compared with non-workers. The prevalence of back pain in the year before the interview was 54 per cent with an odds ratio of 1.49 but a borderline association (Fassa et al., 2002).

There are studies reporting a prevalence of employers' sexual abuse of 80 per cent in Fiji and 25 per cent in Bangladesh (UNICEF, 1999). A study in Lima, Peru identified that 60 per cent of the men who grow up in homes with domestic workers have their first sexual encounter with a domestic worker (UNICEF, 1999).

Auto-repair garages and petrol stations

Children working in garages perform a variety of activities and are in contact with several types of equipment. The main hazards are exposure to chemicals such as benzene, leaded petrol, diesel, rubber adhesives and solvents, acids and metals from batteries, carbon monoxide, asbestos, hot water and engine parts, poor ventilation, and inadequate sanitary and washing facilities (Forastieri, 1997). These exposures can result in injuries, chemical poisoning and dermatitis; but no studies examining child work in garages and its impact on health were found (Forastieri, 1997).

12. Retail

In a survey conducted in 26 developing countries, 8.3 per cent of the child workers aged 5-14 were found to work in retail, and 8.3 per cent of them reported injuries or illnesses (table 39) (ILO, Statistics on Working Children, 1998). This sector employs 50 per cent of the teens in United States mainly in eating places, grocery stores and department stores (Committee on Health and Safety, 1998).

12.1. Main hazards

In several situations, adolescent workers are in violation of the law mainly due to working an excessive number of hours and performing tasks forbidden by law, such as the use of dangerous machinery or equipment and carrying heavy loads (Committee on Health and Safety, 1998). They frequently work late at night, exposed to violence (Castillo et al., 1997).

12.2. Main health outcomes

Work-related injuries

Retail is among the major industry divisions with low rates of fatal injuries (all ages) in the United States, with around three per 100,000 FTE workers (tables 66 and 68 – Chapter IV) (Kisner et al., 1994; Bell et al., 1990). In the Windao et al. (1999) study, among 87 fatalities in retail trade industry under 18-year-olds, 68 per cent were due to assaults or violent acts (64 per cent were homicides) (Windao et al., 1999; Dunn et al., 1993). Grocery stores and restaurants were among the workplaces at greatest risk for work-related homicides (Castillo et al., 1997; Derstine, 1996). Transport accounted for 18 per cent of the fatalities, being 15 per cent highway crashes and, among them, one-third of the victims were newspaper carriers (Windao et al., 1999).

In the retail trade, the proportion of victims younger than 15 years was 7 per cent. Boys accounted for 74 per cent of the fatalities and about 11 per cent of the victims working in family business (Windao et al., 1999).

In several studies in the United States, using data from workers' compensation claims and emergency department rooms, the non-fatal injury rates vary from 0.33 to 14.6 per 100 workers, which is the second highest figure among all major industry divisions (tables 62 and 76 – Chapter IV) (Belville et al., 1993; Schober et al., 1988; Layne et al., 1994). This industry accounts for about three-fifths of the lost workday non-fatal injuries and illnesses occurring among the youth workforce in United States, with 52 per cent in restaurants, 24 per cent in grocery stores and 11 per cent in department stores (Windao et al., 1999; Belville et al., 1993).

Stocking shelves and working at the cash register of grocery stores is legal work for children aged 14 and above in many countries. Yet, there is no literature concerning repetitive motion injuries among child cashiers; such injuries, including carpal tunnel syndrome, are known to pose problems for adult cashiers (Pollack et al., 1990).

13. Scavenging and rag picking

Though frequent in big cities of developing countries, this high-risk activity has been the subject of very few studies, and estimates on the number of children working in this activity were not found (Forastieri, 1997).

13.1. Main hazards

Apart from the low self-esteem typically found among scavengers and rag pickers, they are exposed to a high risk of infection with hepatitis A and B, HIV/AIDS, tetanus, coliforms; food poisoning from eating left-over food; risk of accidents with broken glass and sharp metal; and toxic fumes (Forastieri, 1997; Fassa et al., 2000; UNICEF, 1997). This situation is aggravated in the scavenging and rag-picking of hospital waste, an increasingly lucrative site due to re-use of disposable material (Sharma et al., 1995).

13.2. Main health outcomes

In an ILO study on child scavengers in the Philippines the following disorders were found: high levels of lead and mercury in the blood; battering and gunshot wounds; tetanus; impaired functions; ubiquitous presence of parasites; skin disorders; and others (Forastieri, 1997).

According to Laskar et al. (1996), this occupation makes children vulnerable to worm infestation, lung infections and severe skin diseases. Sometimes, children are bitten by dogs, and their fingers get cut on broken bottles. The most common illness among rag-pickers is tetanus, but they also suffer from coughs, watering eyes, sores, mumps, tuberculosis, and stomach and skin infections. Many garbage children die of curable diseases due to lack of access to health care (Laskar, 1996).

14. Street workers

According to UNICEF, 30 million children in the world work and/or live on the streets, but other sources estimate that this number represents only Latin American street children. Their main activities are guarding and washing cars, selling food and shining shoes.

Some sources estimate that in Brazil alone, there are 10 million children on the streets (Maciel et al., 1997). Studies show that most street workers have a mother or father responsible for them, and if grandparents are included, 92.6 per cent of street workers would have a family member responsible for them (Maciel et al., 1997). More than 80 per cent live with the family, going back home at night or the weekend (Behrens, 1997).

14.1. Main hazards

Street workers are at great risk of road accidents as pedestrian victims, kidnappings, and violence (drugs, sexual abuse) (Richter et al., 1991). There is great concern that street workers might be lured to illicit activities as drug trafficking, thieving and child prostitution increasing the risk of suffering violence (UNICEF, 1997).

14.2. Main health outcomes

Estimates on the road accident incidence rate are not available.

Regarding drug consumption, Behrens et al. (1997) cite that in Brazil 25 to 30 per cent of street children use illicit drugs, mainly marijuana and shoe repair glue in Rio de Janeiro and crack in São Paulo. Alcohol is the drug most frequently consumed (more than 80 per cent), which makes it possible to find a 16-year-old with advanced alcoholism (Behrens, 1997). The author also estimated that 15-20 per cent of the street children had incestuous relationships with a first-grade relative, father or stepfather (Behrens, 1997).

Estimates of the prevalence of HIV/AIDS and other sexually transmissible diseases among street workers were not available.

15. Child prostitution

It is estimated that at least 1 million children in the world are working in prostitution, the majority of them in Asia (Forastieri, 1997; Negrellos, 1997). Commercial sexual exploitation frequently involves the trafficking of children whether they are kidnapped or sold by their parents, frequently under false pretences (UNICEF, 1997; Fassa et al., 2000). Sex tourism is a reality, but locals also actively participate in the sexual exploitation of children (Fassa et al., 2000). However, the new face of exploitation is transnational with criminal networks active across the globe (Bureau of International Labor Affairs, 1996).

15.1. Main hazards

Children in prostitution suffer extreme physical and mental abuse. They are also at risk of drug addiction, AIDS and other sexually transmitted diseases, and early and unwanted pregnancy (UNICEF, 1997; Bureau of International Labor Affairs, 1998; Fassa et al., 2000).

15.2. Main health outcomes

Estimates on the prevalence of any health outcome among children in prostitution were not available.

16. Child soldiers

Brett and McCallin (1996) estimated that there are approximately 250,000 child soldiers worldwide, including many children under 10 years of age, who serve as combatants or as porters, cooks, etc. (table 40) (Wessells, 1997; Southall et al., 2001). Many have been abducted and forcibly recruited; others are drawn by poverty, ideology, promise of wealth, or desire for protection (Wessells, 1997).

16.1. Main hazards

Apart from the risk of been injured in combat, the child soldiers face severe hazards during their “training”. They are exposed to sexual abuse (mainly girls) and torture (mainly boys), so that they will abuse and murder other children who refuse to obey the brutal requests of their adult commanders (Wessells, 1997; Southall et al., 2001). Drugs are often used to induce children to kill and accept the most dangerous missions (Wessells, 1997; Southall et al., 2001). Their values and behaviour are oriented toward violence, bringing long-term difficulties to reintegrate them into civil society (Wessells, 1997).

16.2. Main health outcomes

Studies about the impact of child soldier activity on injury, drug addiction, psychological problems, HIV/AIDS and other sexually transmitted diseases were not encountered.

17. Slavery and bonded labour

The ILO estimated in 1990 that more than 30 million children were in slavery or bondage in several countries. Of these over 10 million were concentrated in India and Pakistan (Forastieri, 1997; UNICEF, 1997). They can be found in plantations, in small workshops from the informal sector in carpet weaving, in match factories, in glass factories, in brick making, in fish cleaning, in mines and quarries; working in domestic services, engaged in child prostitution and as drug carriers (Forastieri, 1997; UNICEF, 1997).

17.1. Main hazards

On the one hand, the hazards faced by children in slavery or bondage will depend of the nature of work in which they are engaged. But on the other hand, independently of the nature of work, these children are vulnerable to several types of abuse. Sometimes, they are kept in captivity, tortured and made to work for very long hours (20 a day) without a break (UNICEF, 1997).

17.2. Main health outcomes

Studies on the health effects of slavery and bondage were not found.

18. Final comments

The available literature describes the children’s activities, identifying their hazards and potential outcomes. However, there are few epidemiological studies pointing out the evidence of the association between child labour and major industry divisions or specific industries and its impact on health. Most of the available information refers to injuries. The studies on illnesses are very few and frequently present several methodological problems.

Thus, it was possible to convert injuries to DALY, but the conversion of illness to DALY was not possible due to a lack of indispensable information. Among the acute diseases the available information refers mainly to the portion of the illness prevalence that could be attributable to work and duration of illness. Among the chronic diseases, occurrence measures and the latency period for workers that had been performing the activities of interest since their childhood or adolescence were not encountered.

It is important to consider that some of the worst forms of child labour such as any form of slavery and bondage, child prostitution and child soldiers severely violate their human rights. Thus, the need for its elimination is independent of its impact on health. The illegal situation of these children implies ethical restrictions that limit the possibility of studying the relationship between these occupations and the morbidity and mortality of child workers.

IV. Translating worst forms of child labour into disability adjusted life years (DALY)

1. Definition of DALY, YLL and YLD

DALY is the sum of the years of life lost due to premature mortality (YLL) in the population and the equivalent "healthy" years lost due to disability (YLD) for incident cases of the health condition (Murray et al., 1996; WHO, 2001).

In short, YLL is the death rate for the studied health outcome multiplied by the standard expectation of life at the age of death, whereas YLD is the incidence rate for the studied health outcome times the duration of disability times the disability weight (Murray et al., 1996; WHO, 2001). The disability weight is a number that varies from zero (state of optimal health) to one (state equivalent to death) that numerically value time lived in non-fatal health states (Murray et al., 1996; WHO, 2001). Murray et al. (1996) proposed the inclusion of two other elements in the YLL and YLD calculations: the discounting rate and the age weighting which generate great controversy, not only on the inclusion or not of these elements but also about their value.

The discounting rate is a standard practice in economic analysis and reduces gradually the years of life lost in the future. Through this approach, measurement of the health outcomes is consistent with cost-effectiveness analysis. It prevents giving excessive weight to deaths at younger ages and deals with the disease eradication paradox assuming that investment in research or disease eradication has a non-zero chance of succeeding (WHO, 2001). The age weighting captures the rising and then falling value of individual years of life lived at different ages (Murray et al., 1996; WHO, 2001).

The full formula to calculate YLL for non-zero discounting rate and age weighting is (Murray et al., 1996).

$$YLL = \frac{Ce^{ra}}{(r+\beta)^2} \left[e^{-(r+\beta)(L+a)} [-(r+\beta)(L+a)-1] - e^{-(r+\beta)a} [-(r+\beta)a-1]\right]$$

Where

r is the discount rate

β is the parameter from the age weighting function

C is a constant

a is the age of death

L is the standard expectation of life at age a

The full formula to calculate YLD for non-zero discounting rate and age weighting is (Murray et al., 1996).

$$YLD = D \frac{Ce^{ra}}{(r+\beta)^2} \left[e^{-(r+\beta)(L+a)} [-(r+\beta)(L+a)-1] - e^{-(r+\beta)a} [-(r+\beta)a-1]\right]$$

Where

r is the discount rate

β is the parameter from the age weighting function

C is a constant

a is the age of onset of the disability

L is the duration of disability

D is the disability weight

The standard figures used in YLL and YLD calculations in the global burden of disease (GBD) are: $r = 0.03$, $\beta = 0.04$, and $C = 0.1658$ (Murray et al., 1996). The formulae presented below used these standards.

A more in-depth presentation of the concepts and assumptions in the DALY formula can be found at:

http://www3.who.int/whosis/menu.cfm?path'whosis,burden&language'english .

2. Bibliographic review

Around 300 papers on child labour were reviewed in the Medline and Lilacs data bank and through the Worldwide Web. All the references of the selected papers were also checked. Most of the reviewed papers are from developed countries, mainly the United States. The few papers from developing countries present mainly descriptive data about the occupations or exposure, but have little on the outcomes. Some of the reviewed papers presented data on adults or for all ages. This data was included in the tables to help making comparisons.

3. The worst forms of child labour and their impact on health

It was assumed that the worst forms of child labour could have three types of negative impact on health:

– exacerbating common diseases with an increase in the prevalence due to occupational exposures;

– determining occupational diseases; and

– causing injuries and premature death.

Some studies, particularly in developing countries, evaluated the prevalence of common diseases in workers as headache, diarrhoea, common cold, malnutrition and others. Most of these studies used a cross-sectional design. The data was mainly descriptive with no or scarce control of confounding factors, important temporal ambiguity in many situations, and lack of some information needed to convert the morbidity to DALY as duration of disability. Moreover, the studies do not clearly present the fraction of the common disease that could be attributable to work.

Other studies evaluated occupational diseases, as musculoskeletal problems, respiratory problems, occupational hearing loss among others. But the information is available for some, very few, particular occupations. Even in these cases important information is lacking on the conversion of morbidity to DALY, such as the duration of the disability and the age of onset of disability for the morbidities with a lengthy latency period.

The most complete set of information available in the literature is on injuries. The studies are restricted to developed countries. Non-fatal injuries feature detailed information on incidence, nature of injury, body Chapter 1njured and relevant data on severity of injury for each major industry division. The papers also present relevant information on fatal injuries but the incidence rate is provided for all child workers and not for major industry division. Moreover, no data is available for the relationship between marginal productive activities and health outcomes.

Although workers' compensation claims (WCC) in the United States include injuries and illness, the studies cited here do not report any details about illnesses. Of the total WCC, illnesses represent a small proportion. Among all claims filed by minors through the State Fund between 1986 and 1989, disease claims represent less than 4 per cent (Heyer et al., 1992). Considering the total United States workforce, injuries account for 98 per cent of all cases of occupational injury and illnesses combined (Runyan et al., 1989). However, in one country survey cited in ILO (1998) among the children that suffered injuries or illnesses, 49 per cent suffered injuries and 51 per cent suffered illnesses.

When evaluating the studies based on WCC, it is important to consider that both injury and illnesses are underreported. Most States require a minimum number of days disabled from work to register a WCC, and illegal workers cannot register. Illnesses, due to their characteristics such as long latency period and greater difficulties to establish the relationship with work, might have higher underreporting than injuries. The survey cited in ILO (1998), on the other hand, evaluates all types of injuries and illnesses, including those that did not result in disability and probably include common diseases whose prevalence cannot be entirely attributable to work.

The formulae presented here were used to calculate the attributable burden of child labour on injuries. All steps will be detailed so that the researcher can use as much local information as available, and can use the estimates provided in this report to cover information that is lacking locally to calculate the DALY. The available evidence on illnesses is presented in Chapter III.

4. Formulae to convert fatal injuries to YLL

To calculate YLL, it is necessary to know standard life expectancy at the age of death. To define this standard, the highest national life expectancy observed was considered. Thus, a life table based on a model, namely Coale and Demeny West Level 26 (table 64), was used. The YLL presented in the table was calculated by the formula presented in the beginning of this report.

5. Estimating fatality rates in each major industry division

The reviewed studies reported rates in full-time equivalent (FTE) workers and in number of workers. The measurement in FTE takes into account the number of hours worked and permits a better comparison between children and adults because children frequently work part-time.

Table 73 shows that the injury fatality rates for all industries vary from 3.4 to 5.6 per 100,000 FTE workers in the adolescents aged 15 to 17. The data available for adults is 6.1 per 100,000 FTE workers, displaying a small difference according to age. The adolescent fatality rates are not available for all major industry divisions. Moreover, looking at the adult rates, it is possible to observe two main patterns: industries with low fatality rate (manufacturing, services and retail), with rates around four per 100,000 FTE workers, and industries with high fatality rates (agriculture, mining and construction), with rates higher than 15 per 100,000 FTE.

Thus, the use of Kisner and Fosbroke (1994) injury fatality rates for all ages for manufacturing, services, retail and mining is suggested due to the absence of any estimate for children (table 74). For construction, the use of Kisner and Fosbroke (1994) injury fatality rates for 16-19-year-olds is recommended, and for agriculture the estimates by Rivara (1985) in Committee on Environmental Health (1995) (table 74). Some authors believe that agriculture has come to surpass mining as the most dangerous occupation in United States. However, small scale mining, frequently illegal, taking place in several developing countries, presents risks much higher than those found in the United States, justifying the acceptance of such high fatality rate (Landrigan et al., 1992; Jennings, 1999).

6. Estimating YLL per 100,000 workers by major industry division

The male standard life expectancy was used because males have higher fatality rates than females. For the 5-14 year-olds, the male standard life expectancy for 10-year-olds (70.4 years) was used, which corresponds to a YLL of 37.47 years. For the 15-17-year-olds, the male standard life expectancy for 15-year-olds (65.41 years) was used, which corresponds to a YLL of 36.80 years (table 64).

7. Converting non-fatal injuries to YLD

To calculate YLD, the disability weight and the duration of disability for each nature of injury proposed by Murray et al. (1996) (table 31) was used. In most of the studies the nature of injury presented by major industry divisions are: cut, laceration and puncture; contusion, concussion, crushing and bruise; sprain and strain; burn and fracture. There is also some information for amputation, a rare event but with lifelong disability, so the YLD for this nature of injury is estimated as well.

8. Estimating YLD for each nature of injury

Since there is no estimate on the amount of injuries treated and untreated, the disability weight for treated injury was used, which underestimates the YLD for untreated injuries.

Cut, laceration and puncture

The disability weight and duration of disability for an open wound was used.

Contusion, concussion and bruises

Since Murray et al. (1996) do not provide disability weight and duration of disability for this nature of injury among the estimates provided the one most similar, i.e. open wound, was chosen.

Sprain and strain

The disability weight and duration of disability for sprain were used.

Burns

Parker et al. (1994) show that 43 per cent of the burns limited activity for less than four days, 27 per cent for four to 13 days, 17 per cent for 14 to 29 days, and 13 per cent for 30 or more days. According to Belville et al. (1993), 25.2 per cent of all burns registered in WCC resulted in permanent disability. But in the Parker et al. (1994) study, 44 per cent of burns left permanent scarring but none resulted in chronic pain, limited use of fingers, hands, arms, legs, or sensory loss. Scarring has not been considered a lifelong disability for the YLD estimate because it might not result in a functional disability. No study reporting severity of burn in terms of body extension affected was found. Parker et al. (1994) information on the number of limited activity days was used to estimate it. Among all burns, 70 per cent limited activities for less than 14 days and were considered burns that affect less than 20 per cent of the body. Those that limited activities for 14 days or more accounted for 30 per cent and were considered burns that affect more than 20 per cent of the body (Belville et al., 1993; Parker et al., 1994).

Fractures

The most detailed information on the injured body parts is from Layne et al. (1994). According to his paper, 39.5 per cent of the fractures or dislocations meant an injured hand or finger, 22.9 per cent leg, knee or ankle, 22 per cent wrist or arm, 4.6 per cent trunk or shoulder, and 10.7 per cent foot or toe. Thus, for hand or fingers, the disability weight and duration of disability of fractured hand bones was considered; for wrist or arm, fractured radius or ulna; for trunk and shoulder, fractured clavicle, scapula, or humerus (short term); and for foot or toe, fractured bones in foot (short term).

A harder decision had to be taken regarding leg, knee or ankle, that have four possible disability weights and duration of disability as follows: fractured femur short term, fractured femur lifelong, fractured patella, tibia, or fibula short term, fractured ankle short term. To help determine the severity indicators were evaluated. According to Belville et al. (1993), 67.9 per cent of fractures result in permanent impairment. According to Parker et al. (1994), 19.4 per cent of the fractures result in permanent impairment, consisting of 6.4 per cent chronic pain, 10.6 per cent limited use of fingers or hands, and 2.1 per cent limited use of leg. In this case, Parker et al. (1994) estimates were used because the detail was useful in the decision needed. Among the cited disability weights and duration of disability groups, only fractured femur has a possible lifelong duration. Thus, among all fractures, the 8.1 per cent fracture femur lifelong were considered. Probably not all chronic pains are in the legs, but the site makes little difference on the disability weight in the lifelong duration. Thus, disability weights and duration of disability of the fracture patella, tibia, or fibula short term, were applied for the remaining 14.8 per cent in leg, knee or ankle, because it presents intermediary disability weights and duration of disability among the short-term injuries in leg, knee or ankle.

Amputation

There is no information about the prevalence of amputation by major industry division. However, it is estimated that amputation is responsible for 0.2 to 0.4 per cent of all injuries (Miller et al., 1998; Parker et al., 1991; Brooks et al., 1993). Despite the low prevalence, it is important to include amputation in the DALY estimation because it causes a lifelong disability.

There is a consensus that most of the amputations (near 100 per cent) affect upper extremities. Fingers account for 82-86 per cent of the amputations, thus it was considered that amputated finger (lifelong) was 86 per cent. According to Parker et al. (1991), 14 per cent of the amputations affect multiple upper extremity parts, and this percentage was considered as amputated arm (lifelong).

9. Estimating the YLD for injury in each major industry division weighted for nature of injury

The most complete set of data on the prevalence of injury by nature is presented in the Layne et al. (1994) study (table 84). However, the author did not estimate the prevalence of amputation and did not include construction and mining. According to Miller and Kaufman (1998), amputations were more frequent in restaurants and food stores (retail), followed by manufacturing and agriculture. Thus, 0.2 per cent of amputations in these three industries were included. For construction, the prevalence estimated by Brooks and Davis (1996) was used. For mining there is no estimate of prevalence by nature of injury; therefore, it is not possible to estimate the YLD specific for this industry. Since mining has the highest fatality and non-fatality rates and is considered one of the most dangerous occupations, the highest YLD for each injury found in the major industry divisions were used in the following calculations (Bell et al., 1990; Kisner et al., 1994; Wilk, 1993).

A proportion of the injuries that is not included in the specified nature of injury is the “Others” group. This group will be included applying the correspondent percentage to the subtotal.

10. Defining the non-fatal injury incidence rate by major industry division

The non-fatal injury incidence rate varies widely from one study to another, in great part due to differences in the studied population and in the exclusion criteria. It seems that studies based on WCC are the ones that exclude injuries without disability, but among those that used data generated at emergency departments the prevalence of some level of disability is also very high. On the other hand, most of the surveys include an important amount of injuries that did not result in disability increasing the incidence rate. Thus, to define the incidence rate to be used in this report the median of the non-fatal incidence rates was determined among the studies based on WCC and emergency departments (tables 69-75).

Layne LA et al. (1994) presented an incidence rate very close to the median for most of the major industry divisions (table 57). This study evaluated a reasonable number of injuries and made nationwide estimates. Moreover, it has already been used for estimating the prevalence of each nature of injury by major industry division. Thus, except for mining, which is not provided in his paper, this report used Layne’s estimates for non-fatal injury incidence rate. For mining this report uses the Schober et al. (1988) estimate because is the one available based on WCC.

11. Estimating DALY per 100 FTE workers per year by major industry division

The first step to calculate DALY is to transform the YLL for agriculture provided for 100,000 workers in 100,000 FTE. The bibliography suggests that 38 per cent of the 5-14-year-olds and 80 per cent of the 15-17-year-olds work full time, it was considered that the others work part time (half number of hours) (ILO, Statistics on Working Children, 1998; ILO, Targeting the Intolerable, 1998). These figures used for the conversion considered just half of the part time workers in the denominator.

12. Estimating the DALY resultant from fatal and non-fatal injuries suffered by child workers in the world

To estimate the DALY resultant from the fatal and non-fatal injuries suffered by child workers in the world, it is necessary to know the number of child workers. The new ILO child labour headcount estimated 211 million economically active children aged 5-14 years, 48 per cent of whom work on a full-time basis (ILO, Every Child Counts, 2002; ILO, Child Labour: Targeting the intolerable, 1998). For the 15-17-year-olds, it was estimated that 141 million are economically active in the world, 80 per cent of whom on a full time basis (ILO, Every Child Counts, 2002; Fausto et al., 1996).

Thus, considering those who do not work full time as working part time (i.e. half the number of hours), there are 156 million FTE workers among the 5-14-year-olds, and 127 million FTE workers among the 15-17-year-olds in the world.

For the child workers aged 5-14, the distribution of workers among the major industry divisions cited by the ILO (1998) for 24 developing countries was used. For the workers aged 15-17, the one cited by Fausto et al. (1996) for Brazil was used, because an estimate for a group of countries that could be more representative of the world distribution was not found

(Fausto et al., 1996). Moreover, due to lack of information for mining for the 15-17-year-olds, the same percentage was maintained as for 5-14-year-olds.

Thus, the estimated total DALY due to work-related fatal and non-fatal injuries was 1.9 million for the 5-14-year-olds and 0.8 million for the 15-17-year-olds, adding up to 2.7 million of DALY due to child labour per year.

13. Important activities with insufficient information for DALY calculation

DALY was not calculated for the unconditional worst forms of child labour, such as sexual exploitation, child soldiers, and drug trafficking, due to the lack of data. However, these activities imply dangerous exposures and lifelong consequences in terms of health and well-being. Thus, performing DALY calculations is recommended using the highest DALY found in the major industry division studied, which in the above estimate is the DALY for mining. Some marginal activities, such as scavenging and rag picking could be treated the same way.

The work in slavery or bondage results in a burden that exceeds the one specific to the activity carried out. It probably has an important negative impact on health due to the circumstances of exploitation and should also receive special treatment. In this case, if the total number of workers in slavery and bondage were known, the highest DALY found in the major industry division studied could also be used. Alternatively, if the number of workers in slavery and bondage by type of activities were known, a multiple of the DALY correspondent to the industry where they are performing their activity could be used.

14. DALY estimates due to HIV/AIDS among sex workers

It is expected that the highest DALY found in the major industry division (mining) underestimate the DALY due to the unconditional worst forms of child labour. To exemplify that this is true, the DALY due to HIV/AIDS among sex workers was calculated.

The reviewed studies estimate the mortality, incidence and/or prevalence of HIV in sex workers (Ward et al., 1999; Gras et al., 1997; Zapiola et al., 1996). This report used the estimates made by Ward et al. (1999) in their study of sex workers in London because the cohort design permitted a direct estimate of the HIV incidence and mortality (Ward et al., 1999). Most of the studies dealt with adult sex workers, whereas studies among child sex workers were not encountered. Preventive behaviour is probably less frequent among children and adolescents. Moreover the rates used were estimated for a developed country and should underestimate the rates for developing countries where the disease is more widespread and preventive measures less applied.

The calculations took into account the HIV incidence of 0.2 per 100 sex workers per year (Ward et al., 1999). Taking into account estimates for the world's population, an average latency period of seven years was considered to change from an HIV case to an AIDS case and another year to become a fatality (Murray et al., 1996). The age of onset was estimated according to the expected natural history of disease.

This estimate shows that for prostitution if just the burden of HIV/AIDS were taken into account, the DALY per 100 persons year would be around three times greater than for mining.

15. Summary of the alternatives to calculate DALY

- If there is information on prevalence of nature of injury by major industry division, prevalence of body site of injury by nature of injury and severity by nature of injury, it is possible to perform all the calculations.

- If the available information is the number of workers per major industry division: multiply it by the DALY per 100 workers per year provided in table 62.

- If the rates for fatal and non-fatal injury are available: First, calculate YLL multiplying the fatality rate by YLL due to a death at each age provided in table 60. Second, calculate YLD multiplying the non-fatal injury rate by YLD per non-fatal injury provided in table 18. Finally, sum YLL and YLD and apply to the population.

16. Final comments

The source of data, i.e. developed countries (mainly the United States), requires a careful use of the estimates. Although some technology could increase the risk of accidents and therefore injuries, it can be expected that these estimates, in general, underestimate the ones expected for developing countries, where the working conditions are usually harder.

DALY due to occupational illness is a topic not solved in this report. There is not sufficient information to consider occupational illnesses comprehensively. It is difficult to establish the injury/illness ratio because the literature presents very different numbers. In the United States, occupational illnesses account for 4 per cent of the WCC among minors, but according to the ILO (1998), illnesses represent 51 per cent of all injuries and illnesses

(Heyer et al., 1992; ILO, Statistics on Working Children, 1998). Moreover, it is not possible to say that one injury will have on average the same DALY as one illness, and probably this relationship will vary widely by major industry division according to the main nature and severity of injury and main illnesses. A personal impression is that often the injuries would have higher DALY than illnesses and that occupational illnesses causing disability would add less than 10 per cent to the total injury DALY.

Moreover, not sufficient information was found on the unconditional worst forms of child labour such as sexual exploitation, child soldiers, slavery and illicit activities, to perform DALY calculations. These activities need an in-depth approach, and it is essential to gather primary data on these forms of child labour.

There is great need for studies in developing countries and studies on the impact of child labour on illnesses. To enhance understanding about the health burden of child labour, it is important to make use of all the available data. In this case, it would be important to extrapolate data available about the impact of work on adult health for children establishing an adult / child risk ratio. Moreover, studies in developing countries, particularly about occupations that are very different from developed countries in terms of exposure (small scale mining for example) could provide the basis for establishing developed / developing countries ratios.

Finally, the estimates presented demanded that the author made several assumptions that could bias the result, but the effort was to base the estimates on a vast bibliographic review in order to make best use of the available information.

Summary of conclusions

The international scourge of child labour is wide-reaching and complex, but its effect of the health of children is unquestioned. The report comprehensively examined how different types of child labour – agricultural and mining, for example – present different health hazards for the hundreds of millions of children at work across the world.

Additionally, the study provided telling statistics through scores of tables and charts that illustrate the dangers that at-work children face on a daily basis. The percentages of non-fatal injuries per 100 full-time workers (table 58), for example, clearly delineates the threats various industries pose to children's health.

It is important to consider that the worst forms of child labour – such as any form of slavery and bondage, child prostitution and child soldiers – severely violate the human rights. Thus, the need for its elimination is independent of its impact on health. The illegal situation of these children implies ethical restrictions that limit the possibility of studying the relationship between these occupations and the morbidity and mortality of child workers.

There is clearly a lack of data on the health benefits of eliminating child labour. For example, there is not a sufficient amount of information available on the unconditional worst forms of child labour to accurately calculate disability adjusted life years (DALY). These activities need an in-depth approach, and it is essential to gather primary data on these forms of child labour.

Appendix: Tables

Table 1. Countries according to economic level

Low-income economies			
Bangladesh	Ghana	Madagascar	Rwanda
Benin	Guinea	Malawi	Sierra Leone
Bhutan	Guinea-Bissau	Mali	Sri Lanka
Burkina Faso	Haiti	Mauritania	Sudan
Burundi	Honduras	Mozambique	Tanzania, United Rep
Central African Rep.	India	Nepal	Togo
Chad	Indonesia	Nicaragua	Uganda
China	Kenya	Niger	Yemen
Egypt	Lao PDR	Nigeria	Zambia
Ethiopia	Lesotho	Pakistan	Zimbabwe
Middle-income economies			
Algeria	Dominican Rep.	Lithuania	Romania
Argentina	Ecuador	Malaysia	Russian Federation
Armenia	El Salvador	Mauritius	Saudi Arabia
Azerbaijan	Estonia	Mexico	Senegal
Belarus	Gabon	Moldova	South Africa
Bolivia	Georgia	Morocco	Syrian Arab Rep.
Botswana	Greece	Namibia	Tajikistan
Brazil	Guatemala	Oman	Thailand
Bulgaria	Hungary	Panama	Trinidad and Tobago
Cameroon	Iran, Islamic Rep.	Papua New Guinea	Tunisia
Chile	Jamaica	Paraguay	Turkey
Colombia	Jordan	Peru	Turkmenistan
Congo	Kazakhstan	Philippines	Ukraine
Costa Rica	Korea, Rep.	Poland	Uruguay
Côte d'Ivoire	Kyrgyzstan	Portugal	Uzbekistan
Czechoslovakia	Latvia	Puerto Rico	Venezuela
			Yugoslavia
High-income economies			
Australia	Finland	Israel	Singapore
Austria	France	Italy	Spain
Belgium	Germany	Japan	Sweden
Canada	Hong Kong	Netherlands	Switzerland
Denmark	Ireland	New Zealand	United Kingdom
		Norway	United States

Source: The World Bank: *World Development Report 1993*: Investing in Health. New York, Oxford University Press, 1993.

Table 2. Countries by demographic region

Sub-Saharan Africa			
Angola	Côte d'Ivoire	Mali	South Africa
Benin	Ethiopia	Mozambique	Sudan
Burkina Faso	Ghana	Niger	Tanzania, United Rep.
Burundi	Guinea	Nigeria	Togo
Cameroon	Kenya	Rwanda	Uganda
Central African Rep.	Madagascar	Senegal	Zaire
Chad	Malawi	Sierra Leone	Zambia
		Somalia*	Zimbabwe
India			
China			
Other Asia			
Bangladesh	Korea, Dem. People's Rep	Myanmar	Singapore
Cambodia	Korea, Rep.	Nepal	Sri Lanka
Hong Kong	Lao PDR	Papua New Guinea	Thailand
Indonesia	Malaysia	Philippines	Viet Nam
Latin America and the Caribbean			
Argentina	Colombia	Guatemala	Paraguay
Bolivia	Cuba	Haiti	Peru
Brazil	Dominican, Rep.	Honduras	Puerto Rico
Chile	Ecuador	Mexico	Uruguay
	El Salvador	Nicaragua	Venezuela
North Africa, Middle East and Central Asia			
Afghanistan	Georgia	Kyrgyzstan	Tajikistan
Algeria	Iran	Libya	Tunisia
Armenia	Iraq	Morocco	Turkey
Azerbaijan	Israel	Pakistan	Turkmenistan
Egypt	Jordan	Saudi Arabia	Uzbekistan
	Kazakhstan	Syrian Arab Rep.	Yemen, Rep.
Central and Eastern Europe			
Albania	Czechoslovakia	Moldova	Russian Federation
Belarus	Hungary	Poland	Ukraine
Bulgaria	Lithuania	Romania	Yugoslavia
Developed countries			
Australia	Finland	Italy	Portugal
Austria	France	Japan	Spain
Belgium	Germany	Netherlands	Sweden
Canada	Greece	New Zealand	Switzerland
Denmark	Ireland	Norway	United Kingdom
			United States

Source: The World Bank, op.cit.

Table 3. Correlation between total primary GER and NER by country income level, and mean, median and standard deviation of total primary GER and NER ratio

Countries income	N	Correlation coefficient	Mean	Median	SD
Low	25	0.895 **	1.29	1.22	0.28
Middle	45	0.808 **	1.14	1.13	0.11
High	19	0.265	1.06	1.06	0.05
Total	89	0.889 **	1.17	1.13	0.19

SD = standard deviation; * p ≤ 0.05; ** p ≤ 0.01.

Sources: (a) UNESCO: *The right to education: Towards education for all throughout life,* Paris, 2000. (b) The World Bank, op. cit. (c) Own estimates.

Table 4. Correlation between male primary GER and NER by country income level, and mean, median and standard deviation of male primary GER and NER ratio

Countries income	n	Correlation coefficient	Mean	Median	SD
Low	24	0.860 **	1.32	1.25	0.30
Middle	41	0.817 **	1.13	1.15	0.09
High	19	0.299	1.07	1.07	0.05
Total	84	0.860 **	1.17	1.14	0.20

SD = standard deviation; * p ≤ 0.05; ** p ≤ 0.01.

Sources: (a) UNESCO: *The right to education: Towards education for all throughout life,* Paris, 2000. (b) The World Bank, op. cit. (c) Own estimates.

Table 5. Correlation between female primary GER and NER by country income level, and mean, median and standard deviation of female primary GER and NER ratio

Countries income	n	Correlation coefficient	Mean	Median	SD
Low	24	0.917 **	1.25	1.22	0.28
Middle	41	0.903 **	1.11	1.12	0.08
High	19	0.265	1.06	1.05	0.05
Total	84	0.928 **	1.14	1.11	0.17

SD = standard deviation; * p ≤ 0.05; ** p ≤ 0.01.

Sources: (a) UNESCO: *The right to education: Towards education for all throughout life,* Paris, 2000. (b) The World Bank, op. cit. (c) Own estimates.

Table 6. Correlation between total secondary GER and NER by country income level, and mean, median and standard deviation of total secondary GER and NER ratio

Countries income	N	Correlation coefficient	Mean	Median	SD
Low	12	0.983 **	1.30	1.25	0.23
Middle	33	0.889 **	1.26	1.19	0.37
High	17	0.577	1.15	1.15	0.11
Total	62	0.958 **	1.24	1.17	0.30

SD = standard deviation; * p ≤ 0.05; ** p ≤ 0.01.

Sources: (a) UNESCO: *The right to education: Towards education for all throughout life,* Paris, 2000. (b) The World Bank, op. cit. (c) Own estimates.

Table 7. Correlation between male secondary GER and NER by country income level, and mean, median and standard deviation of male secondary GER and NER ratio

Countries income	N	Correlation coefficient	Mean	Median	SD
Low	11	0.983 **	1.32	1.20	0.32
Middle	29	0.902 **	1.24	1.19	0.33
High	16	0.638	1.16	1.15	0.11
Total	56	0.959 **	1.24	1.17	0.29

SD = standard deviation; * $p \leq 0.05$; ** $p \leq 0.01$.

Sources: (a) UNESCO: *The right to education: Towards education for all throughout life,* Paris, 2000. (b) The World Bank, op. cit. (c) Own estimates.

Table 8. Correlation between female secondary GER and NER by country income level, and mean, median and standard deviation of female secondary GER and NER ratio

Countries income	N	Correlation coefficient	Mean	Median	SD
Low	111	0.990 **	1.22	1.20	0.16
Middle	29	0.872 **	1.21	1.18	0.30
High	16	0.689	1.16	1.14	0.10
Total	56	0.958 **	1.19	1.16	0.23

SD = standard deviation; * $p \leq 0.05$; ** $p \leq 0.01$.

Sources: (a) UNESCO: *The right to education: Towards education for all throughout life,* Paris, 2000. (b) The World Bank, op. cit. (c) Own estimates.

Table 9. Average values of each variable

Health aspects	Low-income		Middle-income		High-income		All countries	
Total primary estimated NER (%)	83	&	90	&	97	&	87	&
Female primary estimated NER (%)	77	&	90	&	97	&	83	&
Male primary estimated NER (%)	88	&	91	&	96	&	90	&
Total secondary estimated NER (%)	33	&	53	&	86	&	47	&
Female secondary estimated NER (%)	30	&	57	&	86	&	45	&
Male secondary estimated NER (%)	40	&	58	&	83	&	51	&
Disability adjusted life years/1 000 in 1990	98	&	37	&	20	&	51	&
GNP per capita (US dollars)	350	w	2 480	w	21 050	w	4 010	w

w = weighted averages. & = estimated by this report weighted for countries' population.

Sources: World Bank, op.cit.; own estimates.

Table 10. Association between gross education enrolment 1990 and DALY per 1,000 population, examining data for each country

Gross primary education enrolment	Low-income n = 25				Middle-income n = 32				High-income n = 17				All countries n = 78			
	β	β#	SE	p	β	β#	SE	p	β	β#	SE	p	β	β#	SE	p
Male	-0.97	-0.58	0.28	*	-0.71	-0.38	0.20		0.05	0.14	0.18		-1.53	-0.74	0.15	**
Female	-1.10	-0.64	0.24	*	-0.93	-0.47	0.17	**	0.03	0.18	0.22		-1.58	-0.87	0.13	**
Total	-1.14	-0.66	0.27	*	-0.83	-0.42	0.17	*	0.06	0.18	0.21		-1.69	-0.86	0.14	**
Gross secondary education enrolment	**Low-income n = 25**				**Middle-income n = 32**				**High-income N = 17**				**All countries n = 78**			
	β	β&	SE	p	β	β&	SE	p	β	β&	SE	p	β	β&	SE	p
Male	-1.56	-0.54	0.50		-0.68	-0.45	0.13	**	0.11	0.09	0.06		-1.23	-0.52	0.16	**
Female	-1.85	-0.74	0.45		-0.67	-0.38	0.12	**	0.10	0.09	0.06		-1.15	-0.39	0.14	**
Total	-1.82	-0.71	0.48		-0.67	-0.46	0.11	**	0.11	0.09	0.07		-1.20	-0.51	0.14	**

B = crude regression coefficient; b# = regression coefficient adjusted for log of GNP and secondary education enrolment; b& = regression coefficient adjusted for log of GNP and primary education enrolment; SE = standard error; p = ≤ 0.05; ** p = ≤ 0.01.

Data source on DALY and GNP: The World Bank, op.cit.
Data source on gross education enrolment: UNESCO: *The right to education: Towards education for all throughout life,* Paris, 2000.

Table 11. Association between net enrolment 1990 and DALY per 1,000 population, examining data for each country

Net primary education enrolment	Low-income n = 8				Middle-income n = 19				High-income n = 13				All countries n = 44			
	β	β#	SE	p	β	β#	SE	P	β	β#	SE	p	β	β#	SE	p
Male	-1.33	-0.29	0.33		-0.24	-0.04	0.55		0.13	-0.03	0.17		-2.03	-1.19	0.23	**
Female	-1.21	-0.37	0.34		-0.60	-0.40	0.48		0.09	-0.06	0.19		-1.81	-1.14	0.20	**
Total	-1.42	-0.61	0.35		-0.19	0.13	0.39		-0.03	-0.07	0.22		-1.87	-1.19	0.21	**
Net secondary education enrolment	**Low-income n = 8**				**Middle-income n = 19**				**High-income n = 13**				**All countries n = 44**			
	β	β&	SE	p	β	β&	SE	P	β	β&	SE	p	β	β&	SE	p
Male	-2.01	-1.14	0.49		-0.46	-0.31	0.25		0.30	0.38	0.17	*	-1.38	-0.18	0.23	
Female	-1.98	-0.91	0.55		-0.51	-0.25	0.24		0.36	0.44	0.17	*	-1.28	-0.15	0.22	
Total	-2.08	-0.60	0.54		-0.43	-0.38	0.19		0.16	0.22	0.20		-1.21	-0.13	0.21	

B = crude regression coefficient; b# = regression coefficient adjusted for log of GNP and secondary education enrolment; b& = regression coefficient adjusted for log of GNP and primary education enrolment; SE = standard error; p = ≤ 0.05; ** p = ≤ 0.01.

Data source on DALY and GNP: The World Bank, op.cit.
Data source on gross education enrolment: UNESCO, op. cit.

Table 12. Association between estimated net enrolment 1990 and DALY per 1,000 population, examining data for each country

Estimated net primary education enrolment	Low-income n = 31				Middle-income n = 43				High-income n = 19				All countries n = 95			
	β	β#	SE	p	β	β#	SE	p	β	β#	SE	p	β	β#	SE	p
Male	-1.36	-0.76	0.38	*	-1.02	-0.56	0.24	*	0.17	0.02	0.15		-2.00	-1.03	0.19	**
Female	-1.44	-0.81	0.33	*	-1.09	-0.62	0.19	**	0.14	-0.00	0.18		-1.76	-1.09	0.15	**
Total	-1.51	-0.90	0.37	*	-0.95	-0.46	0.20	*	0.14	0.02	0.19		-1.92	-1.09	0.17	**
Estimated net secondary education enrolment	**Low-income n = 31**				**Middle-income n = 43**				**High-income n = 19**				**All countries n = 95**			
	β	β&	SE	p	β	β&	SE	p	β	β&	SE	p	β	β&	SE	p
Male	-1.90	-0.67	0.62		-0.72	-0.41	0.15	**	0.29	0.30	0.12	*	-1.40	-0.47	0.19	*
Female	-2.07	-0.81	0.52		-0.74	-0.37	0.14	*	0.27	0.25	0.12	*	-1.32	-0.38	0.16	*
Total	-2.14	-0.73	0.59		-0.72	-0.44	0.13	**	0.18	0.15	0.13		-1.34	-0.45	0.16	**

B = crude regression coefficient; b# = regression coefficient adjusted for log of GNP and secondary education enrolment; b& = regression coefficient adjusted for log of GNP and primary education enrolment; SE = standard error; p = ≤ 0.05; ** p = ≤ 0.01.

Data source on DALY and GNP: The World Bank, op.cit.
Data source on gross education enrolment: UNESCO, op. cit.

Table 13. Mean, median and standard deviation of the percentage of DALY reduction (non-weighted for population) in the expansion to 100 per cent net enrolment ratios by country income level

Estimated net primary education enrolment	Low-income n = 36			Middle-income n = 46			Low and middle countries n = 82		
	Mean	Median	SE	Mean	Median	SE	Mean	Median	SE
Male	22.8	23.0	12.7	16.9	16.5	15.3	19.5	20.0	14.5
Female	32.0	30.0	13.4	20.2	19.5	16.4	25.4	25.5	16.2
Total	30.9	30.5	14.0	16.0	14.5	15.3	22.4	21.0	16.4
Estimated net secondary education enrolment	**Low-income n = 36**			**Middle-income n = 46**			**Low and middle countries n = 82**		
	Mean	Median	SE	Mean	Median	SE	Mean	Median	SE
Male	53.5	44.5	22.8	52.1	43.0	27.1	52.7	44.0	25.2
Female	65.0	56.0	26.9	47.1	39.5	22.7	55.0	51.5	26.1
Total	61.0	50.5	25.8	56.1	47.0	27.1	58.2	50.0	26.5

Sources: The World Bank, op.cit.: UNESCO, op.cit.; own estimates.

Table 14. Impact of expanding male primary NER to 100 per cent on DALY in low-income countries (regression coefficient – 0.76)

Low-income countries	Population in millions	% enrolled	Actual DALY/1 000	DALY reduction/1 000	% of reduction
Mozambique	16	49.0	183.3	39	21
Tanzania, United Rep. of	25	51.0	145.6	37	26
Ethiopia	53	39.0	139.1	46	33
Uganda	17	66.4	139.1	26	18
Bhutan	1	–	–	–	–
Guinea-Bissau	1	56.0	–	–	
Nepal	19	100.0	104.8	0	0
Burundi	6	63.2	105.3	28	27
Chad	6	59.0	137.8	31	23
Madagascar	12	59.0	81.9	31	38
Sierra Leone	4	48.0	244.4	40	16
Bangladesh	111	68.0	107.9	24	23
Lao PDR	4	66.0	145.5	26	18
Malawi	9	52.0	143.0	36	26
Rwanda	7	66.0	161.2	26	16
Mali	9	27.0	140.4	55	40
Burkina Faso	9	33.0	148.2	51	34
Niger	8	32.0	157.3	52	33
India	866	88.0	94.0	9	10
Kenya	25	77.6	58.5	17	29
Nigeria	99	83.2	127.4	13	10
China	1 150	99.0	34.0	1	2
Haiti	7	22.0	122.4	59	48
Benin	5	65.0	115.7	27	23
Central African Rep.	3	64.0	96.2	27	28
Ghana	15	65.6	71.5	26	37
Pakistan	116	65.6	89.4	26	29
Togo	4	87.0	102.7	10	10
Guinea	6	50.0	162.5	38	23
Nicaragua	4	71.0	79.8	22	28
Sri Lanka	17	85.6	21.9	11	50
Mauritania	2	61.0	–	–	–
Yemen, Rep.	13	80.0	152.4	15	10
Honduras	5	84.0	47.9	12	25
Lesotho	2	65.0	–	–	–
Indonesia	181	100.0	56.3	0	0
Egypt, Arab Rep.	54	98.0	48.3	2	3
Zimbabwe	10	93.6	48.1	5	10
Sudan	26	48.0	109.2	40	36
Zambia	8	76.0	111.8	18	16
Total (just countries with complete data set)	2 929	88.0	71.6	9	13

Sources: The World Bank, op.cit.: UNESCO, op.cit.

Table 15. Impact of expanding male primary NER to 100 per cent on DALY in middle-income countries (regression coefficient – 0.56)

Middle-income countries	Population in millions	% enrolled	Actual DALY/1 000	DALY reduction/1 000	% of reduction
Bolivia	7	95.0	105.0	3	3
Côte d'Ivoire	12	63.0	65.0	21	32
Senegal	8	55.0	128.7	25	20
Philippines	63	98.3	42.2	1	2
Papua New Guinea	4	67.8	123.6	18	15
Cameroon	12	94.8	87.1	3	3
Guatemala	9	76.0	72.7	13	18
Dominican Rep.	7	81.7	42.6	10	24
Ecuador	11	100.0	37.3	0	0
Morocco	26	68.0	63.0	18	28
Jordan	4	–	26.4	–	–
Tajikistan	5	80.0	35.2	11	32
Peru	22	91.0	56.8	5	9
El Salvador	5	78.0	49.7	12	25
Congo	2	100.0	–	–	–
Syrian Arab Rep.	13	100.0	36.6	0	0
Colombia	33	82.6	19.5	10	50
Paraguay	4	94.0	39.0	3	9
Uzbekistan	21	71.3	29.3	16	55
Jamaica	2	96.0	–	–	–
Romania	23	96.0	32.1	2	7
Namibia	1	100.0	–	–	–
Tunisia	8	97.0	30.8	2	5
Kyrgyzstan	4	96.0	29.3	2	8
Thailand	57	87.0	34.4	7	21
Georgia	5	88.0	22.0	7	31
Azerbaijan	7	99.1	23.4	0	2
Turkmenistan	4	–	42.5	–	–
Turkey	57	100.0	45.4	0	0
Poland	38	97.0	27.0	2	6
Bulgaria	9	86.0	25.3	8	31
Costa Rica	3	86.0	–	–	–
Algeria	26	99.0	39.6	1	1
Panama	2	91.0	–	–	–
Armenia	3	–	20.5	–	–
Chile	13	90.0	23.1	6	24
Iran, Islamic Rep.	58	100.0	46.9	0	0
Moldova	4	80.9	32.1	11	33
Ukraine	52	77.4	27.0	13	47
Mauritius	1	95.0	–	–	–
Czechoslovakia	16	–	27.0	–	–
Kazakhstan	17	84.3	27.8	9	31
Malaysia	18	100.0	23.5	0	0
Botswana	1	90.0	–	–	–

Middle-income countries	Population in millions	% enrolled	Actual DALY/1 000	DALY reduction/1 000	% of reduction
South Africa	39	100.0	52.0	0	0
Lithuania	4	80.9	32.1	11	33
Hungary	10	91.0	25.3	5	20
Venezuela	20	87.0	23.1	7	32
Argentina	33	99.1	21.3	0	2
Uruguay	3	91.0	26.6	5	19
Brazil	151	–	46.1	–	–
Mexico	83	100.0	30.2	0	0
Belarus	10	87.0	23.6	7	31
Russian Federation	149	93.0	28.7	4	14
Latvia	3	92.0	–	–	–
Trinidad and Tobago	1	91.0	–	–	–
Gabon	1	–	–	–	–
Estonia	2	87.0	–	–	–
Portugal	10	100.0	22.8	0	0
Oman	2	73.0	–	–	–
Puerto Rico	4	–	17.7	–	–
Korea, Rep.	43	100.0	15.6	0	0
Greece	10	94.0	19.0	3	18
Saudi Arabia	15	65.0	54.0	20	36
Yugoslavia	24	69.0	–	–	–
Total (countries with complete data set)	1 087	91.7	36.4	5	13

Sources: The World Bank, op.cit.: UNESCO, op.cit.

Table 16. Impact of expanding female primary NER to 100 per cent on DALY of low-income countries (regression coefficient – 0.81)

Low-income countries	Population in millions	% enrolled	Actual DALY/1 000	DALY reduction/1 000	% of reduction
Mozambique	16	38.0	183.3	50	27
Tanzania, United Rep.	25	52.0	145.6	39	27
Ethiopia	53	24.0	139.1	62	44
Uganda	17	54.1	139.1	37	27
Bhutan	1	–	–	–	–
Guinea-Bissau	1	31.1	–	–	–
Nepal	19	66.4	104.8	27	26
Burundi	6	54.1	105.3	37	35
Chad	6	33.0	137.8	54	39
Madagascar	12	62.0	81.9	31	38
Sierra Leone	4	33.6	244.4	54	22
Bangladesh	111	60.0	107.9	32	30
Lao PDR	4	57.0	145.5	35	24
Malawi	9	48.0	143.0	42	29

Low-income countries	Population in millions	% enrolled	Actual DALY/1 000	DALY reduction/1 000	% of reduction
Rwanda	7	66.0	161.2	28	17
Mali	9	16.0	140.4	68	48
Burkina Faso	9	21.0	148.2	64	43
Niger	8	18.0	157.3	66	42
India	866	68.9	94.0	25	27
Kenya	25	76.2	58.5	19	33
Nigeria	99	64.8	127.4	29	22
China	1 150	95.0	34.0	4	12
Haiti	7	23.0	122.4	62	51
Benin	5	32.0	115.7	55	48
Central African Rep.	3	42.0	96.2	47	49
Ghana	15	55.7	71.5	36	50
Pakistan	116	32.0	89.4	55	62
Togo	4	62.0	102.7	31	30
Guinea	6	33.0	162.5	54	33
Nicaragua	4	73.0	79.8	22	27
Sri Lanka	17	86.1	21.9	11	52
Mauritania	2	53.0	–	–	–
Yemen, Rep.	13	32.8	152.4	54	36
Honduras	5	90.2	47.9	8	17
Lesotho	2	81.0	–	–	–
Indonesia	181	95.0	56.3	4	7
Egypt	54	88.0	48.3	10	20
Zimbabwe	10	94.3	48.1	4	7
Sudan	26	36.9	109.2	39	36
Zambia	8	74.0	111.8	16	14
Total (countries with complete data set)	2 290	76.7	71.6	19	26

Sources: The World Bank, op.cit.: UNESCO, op.cit.

Table 17. Impact of expanding female primary NER to 100 per cent on DALY in middle-income countries (regression coefficient – 0.62)

Middle-income countries	Population in millions	% enrolled	Actual DALY/ 1 000	DALY reduction/ 1 000	% of reduction
Bolivia	7	87.0	104.7	8	8
Côte d'Ivoire	12	47.0	65.0	33	51
Senegal	8	41.0	128.7	37	28
Philippines	63	97.3	42.2	2	4
Papua New Guinea	4	58.9	123.6	25	21
Cameroon	12	83.0	87.1	11	12
Guatemala	9	78.0	72.7	14	19
Dominican Rep.	7	83.9	42.6	10	23
Ecuador	11	100.0	37.3	0	0

Middle-income countries	Population in millions	% enrolled	Actual DALY/ 1 000	DALY reduction/ 1 000	% of reduction
Morocco	26	48.0	63.0	32	51
Jordan	4	–	26.4	–	–
Tajikistan	5	80.4	35.2	12	35
Peru	22	90.0	56.8	6	11
El Salvador	5	78.0	49.7	14	27
Congo	2	100.0	–	–	–
Syrian Arab Rep.	13	93.0	36.6	4	12
Colombia	33	97.3	19.5	2	9
Paraguay	4	92.0	39.0	5	13
Uzbekistan	21	72.3	29.3	17	59
Jamaica	2	96.0	–	–	–
Romania	23	95.0	32.1	3	10
Namibia	1	100.0	–	–	–
Tunisia	8	90.0	30.8	6	20
Kyrgyzstan	4	93.0	29.3	4	15
Thailand	57	87.5	34.4	8	23
Georgia	5	91.0	22.0	6	25
Azerbaijan	7	100.0	23.4	0	0
Turkmenistan	4	–	42.5	–	–
Turkey	57	96.0	45.4	2	5
Poland	38	97.0	27.0	2	7
Bulgaria	9	86.0	25.3	9	34
Costa Rica	3	87.0	–	–	–
Algeria	26	87.0	39.6	8	20
Panama	2	92.0	–	–	–
Armenia	3	–	20.5	–	–
Chile	13	88.0	23.1	7	32
Iran, Islamic Rep.	58	96.0	46.9	2	5
Moldova	4	83.0	32.1	11	33
Ukraine	52	79.5	27.0	13	47
Mauritius	1	95.0	–	–	–
Czechoslovakia	16	–	27.0	–	–
Kazakhstan	17	87.5	27.8	8	28
Malaysia	18	100.0	23.5	0	0
Botswana	1	97.0	–	–	–
South Africa	39	100.0	52.0	0	0
Lithuania	4	78.6	32.1	13	41
Hungary	10	92.0	25.3	5	20
Venezuela	20	89.0	23.1	7	30
Argentina	33	100.0	21.3	0	0
Uruguay	3	92.0	26.6	5	19

Middle-income countries	Population in millions	% enrolled	Actual DALY/ 1 000	DALY reduction/ 1 000	% of reduction
Brazil	151	–	46.1	–	–
Mexico	83	100.0	30.2	0	0
Belarus	10	84.0	23.6	10	42
Russian Federation	149	93.0	28.7	4	15
Latvia	3	87.0	–	–	–
Trinidad and Tobago	1	91.0	–	–	–
Gabon	1	–	–	–	–
Estonia	2	88.0	–	–	–
Portugal	10	100.0	22.8	0	0
Oman	2	68.0	–	–	–
Puerto Rico	4	–	17.7	–	–
Korea, Rep.	43	100.0	15.6	0	0
Greece	10	94.0	19.0	4	20
Saudi Arabia	15	53.0	54.2	29	54
Yugoslavia	24	70.0	–	–	–
Total (just countries with complete data set)	1 087	90.3	36.4	6	16

Sources: The World Bank, op.cit.: UNESCO, op.cit.

Table 18. Impact of expanding total primary NER to 100 per cent on DALY in low-income countries (regression coefficient – 0.90)

Low-income countries	Population in millions	% enrolled	Actual DALY/1 000	DALY reduction/1 000	% of reduction
Mozambique	16	44.0	183.3	50	27
Tanzania, United Rep.	25	51.0	145.6	44	30
Ethiopia	53	32.0	139.1	61	44
Uganda	17	60.7	139.1	35	25
Bhutan	1	–	–	–	–
Guinea-Bissau	1	44.3	–	–	–
Nepal	19	88.5	104.8	10	10
Burundi	6	59.8	105.3	36	34
Chad	6	46.0	137.8	49	35
Madagascar	12	61.0	81.9	35	43
Sierra Leone	4	41.0	244.4	53	22
Bangladesh	111	64.0	107.9	32	30
Lao PDR	4	61.0	145.5	35	24
Malawi	9	50.0	143.0	45	31
Rwanda	7	66.0	161.2	31	19
Mali	9	21.0	140.4	71	51
Burkina Faso	9	27.0	148.2	66	44
Niger	8	25.0	157.3	68	43
India	866	79.5	94.0	18	20
Kenya	25	77.9	58.5	20	34

Low-income countries	Population in millions	% enrolled	Actual DALY/1 000	DALY reduction/1 000	% of reduction
Nigeria	99	74.6	127.4	23	18
China	1 150	97.0	34.0	3	8
Haiti	7	22.0	122.4	70	57
Benin	5	49.0	115.7	46	40
Central African Rep.	3	53.0	96.2	42	44
Ghana	15	61.5	71.5	35	48
Pakistan	116	50.0	89.4	45	50
Togo	4	75.0	102.7	23	22
Guinea	6	42.0	162.5	52	32
Nicaragua	4	72.0	79.8	25	32
Sri Lanka	17	86.9	21.9	12	54
Mauritania	2	57.0	–	–	–
Yemen, Rep.	13	57.4	152.4	38	25
Honduras	5	89.0	47.9	10	21
Lesotho	2	73.0	–	–	–
Indonesia	181	97.0	56.3	3	5
Egypt	54	93.0	48.3	6	13
Zimbabwe	10	95.1	48.1	4	9
Sudan	26	43.4	109.2	51	47
Zambia	8	75.0	111.8	23	20
Total (countries with complete data set)	2 929	82.8	71.6	15	22

Sources: The World Bank, op.cit.: UNESCO, op.cit.

Table 19. Impact of expanding total primary NER to 100 per cent on DALY in middle-income countries (regression coefficient – 0.46)

Middle-income countries	Population in millions	% enrolled	Actual DALY/1 000	DALY reduction/1 000	% of reduction
Bolivia	7	91.0	104.7	4	4
Côte d'Ivoire	12	55.0	65.0	21	32
Senegal	8	48.0	128.7	24	19
Philippines	63	97.0	42.2	1	3
Papua New Guinea	4	63.7	123.6	17	14
Cameroon	12	89.4	87.1	5	6
Guatemala	9	72.0	72.7	13	18
Dominican Rep.	7	83.2	42.6	8	18
Ecuador	11	100.0	37.3	0	0
Morocco	26	58.0	63.0	19	31
Jordan	4	–	26.4	–	–
Tajikistan	5	80.5	35.2	9	25
Peru	22	91.0	56.8	4	7
El Salvador	5	78.0	49.7	10	20
Congo	2	100.0	–	–	–

Middle-income countries	Population in millions	% enrolled	Actual DALY/1 000	DALY reduction/1 000	% of reduction
Syrian Arab Rep.	13	98.0	36.6	1	3
Colombia	33	69.0	19.5	14	73
Paraguay	4	93.0	39.0	3	8
Uzbekistan	21	71.7	29.3	13	44
Jamaica	2	96.0	–	46	
Romania	23	95.0	32.1	2	7
Namibia	1	89.0	–	–	–
Tunisia	8	94.0	30.8	3	9
Kyrgyzstan	4	95.0	29.3	2	8
Thailand	57	87.6	34.4	6	17
Georgia	5	90.0	22.0	5	21
Azerbaijan	7	100.0	23.4	0	0
Turkmenistan	4	–	42.5	–	–
Turkey	57	99.0	45.4	0	1
Poland	38	97.0	27.0	1	5
Bulgaria	9	86.0	25.3	6	25
Costa Rica	3	86.0	–	–	–
Algeria	26	93.0	39.6	3	8
Panama	2	91.0	–	–	–
Armenia	3	77.0	20.5	11	52
Chile	13	89.0	23.1	5	22
Iran, Islamic Rep.	58	99.0	46.9	0	1
Moldova	4	82.3	32.1	8	25
Ukraine	52	78.8	27.0	10	36
Mauritius	1	95.0	–	–	–
Czechoslovakia	16	–	27.0	–	–
Kazakhstan	17	86.7	27.8	6	22
Malaysia	18	100.0	23.5	0	0
Botswana	1	93.0	–	–	–
South Africa	39	100.0	52.0	0	0
Lithuania	4	80.5	32.1	9	28
Hungary	10	91.0	25.3	4	16
Venezuela	20	88.0	23.1	6	24
Argentina	33	100.0	21.3	0	0
Uruguay	3	91.0	26.6	4	16
Brazil	151	86.0	46.1	6	14
Mexico	83	100.0	30.2	0	0
Belarus	10	85.0	23.6	7	29
Russian Federation	149	96.0	28.7	2	6
Latvia	3	89.0	–	–	–
Trinidad and Tobago	1	91.0	–	–	–

Middle-income countries	Population in millions	% enrolled	Actual DALY/1 000	DALY reduction/1 000	% of reduction
Gabon	1	–	–	–	–
Estonia	2	87.0	–	–	–
Portugal	10	100.0	22.8	0	0
Oman	2	70.0	–	–	–
Puerto Rico	4	–	17.7	–	–
Korea, Rep.	43	100.0	15.6	0	0
Greece	10	94.0	19.0	3	15
Saudi Arabia	15	59.0	54.2	19	35
Yugoslavia	24	69.0	–	–	–
Total (countries with complete data set)	1 241	90.3	37.5	4	12

Sources: The World Bank, op.cit.: UNESCO, op.cit.

Table 20. Impact of expanding male secondary NER to 100 per cent on DALY in low-income countries (regression coefficient – 0.67)

Low-income countries	Population in millions	% enrolled	Actual DALY/1 000	DALY reduction/1 000	% of reduction
Mozambique	16	7.0	183.3	62	34
Tanzania, United Rep.	25	5.0	145.6	64	44
Ethiopia	53	13.3	139.1	58	42
Uganda	17	14.2	139.1	58	41
Bhutan	1	–	–	–	–
Guinea-Bissau	1	–	–	–	–
Nepal	19	13.3	104.8	58	55
Burundi	6	5.8	105.3	63	60
Chad	6	10.8	137.8	60	43
Madagascar	12	15.0	81.9	57	70
Sierra Leone	4	18.3	244.4	55	22
Bangladesh	111	24.0	107.9	51	47
Lao PDR	4	17.0	145.5	56	38
Malawi	9	9.2	143.0	61	43
Rwanda	7	8.0	161.2	62	38
Mali	9	7.0	140.4	62	44
Burkina Faso	9	9.0	148.2	61	41
Niger	8	8.0	157.3	62	39
India	866	45.8	94.0	36	39
Kenya	25	23.3	58.5	51	88
Nigeria	99	24.2	127.4	51	40
China	1 150	45.8	34.0	36	107
Haiti	7	17.5	122.4	55	45
Benin	5	14.2	115.7	58	50
Central African Rep.	3	14.2	96.2	58	60
Ghana	15	37.5	71.5	42	59

Low-income countries	Population in millions	% enrolled	Actual DALY/1 000	DALY reduction/1 000	% of reduction
Pakistan	116	25.0	89.4	50	56
Togo	4	26.0	102.7	50	48
Guinea	6	12.5	162.5	59	36
Nicaragua	4	28.3	79.8	48	60
Sri Lanka	17	59.2	21.9	27	125
Mauritania	2	15.8	–	–	–
Yemen, Rep.	13	44.2	152.4	37	25
Honduras	5	24.2	47.9	51	106
Lesotho	2	10.0	–	–	–
Indonesia	181	40.0	56.3	40	71
Egypt	54	71.0	48.3	19	40
Zimbabwe	10	44.2	48.1	37	78
Sudan	26	22.5	109.2	52	48
Zambia	8	28.3	111.8	48	43
Total (countries with complete data set)	2 929	40.4	71.6	40	56

Sources: The World Bank, op.cit.: UNESCO, op.cit.

Table 21. Impact of expanding male secondary NER to 100 per cent on DALY in middle-income countries (regression coefficient – 0.41)

Middle-income countries	Population in millions	% enrolled	Actual DALY/1 000	DALY reduction/1 000	% of reduction
Bolivia	7	32.0	104.7	28	27
Côte d'Ivoire	12	25.2	65.0	31	47
Senegal	8	17.6	128.7	34	26
Philippines	63	62.2	42.2	16	37
Papua New Guinea	4	12.6	123.6	36	29
Cameroon	12	27.7	87.1	30	34
Guatemala	9	22.7	72.7	32	44
Dominican Rep.	7	18.0	42.6	34	79
Ecuador	11	42.0	37.3	24	64
Morocco	26	34.5	63.0	27	43
Jordan	4	–	26.4	–	–
Tajikistan	5	69.7	35.2	12	35
Peru	22	54.0	56.8	19	33
El Salvador	5	21.0	49.7	32	65
Congo	2	52.1	–	–	–
Syrian Arab Rep.	13	52.0	36.6	20	54
Colombia	33	42.0	19.5	24	122
Paraguay	4	25.0	39.0	31	79
Uzbekistan	21	87.4	29.3	5	18
Jamaica	2	62.0	–	–	–
Romania	23	72.0	32.1	11	36

Namibia	1	32.8	–	–	–
Tunisia	8	46.0	30.8	22	72
Kyrgyzstan	4	83.2	29.3	7	24
Thailand	57	26.1	34.4	30	88
Georgia	5	75.0	22.0	10	47
Azerbaijan	7	75.6	23.4	10	43
Turkmenistan	4	–	42.5	–	–
Turkey	57	59.0	45.4	17	37
Poland	38	73.0	27.0	11	41
Bulgaria	9	62.0	25.3	16	62
Costa Rica	3	–	–	–	–
Algeria	26	60.0	39.6	16	41
Panama	2	48.0	–	–	–
Armenia	3	84.0	20.5	7	32
Chile	13	53.0	23.1	19	84
Iran, Islamic Rep.	58	74.0	46.9	11	23
Moldova	4	64.7	32.1	14	45
Ukraine	52	–	27.0	–	–
Mauritius	1	44.5	–	–	–
Czechoslovakia	16	–	27.0	–	–
Kazakhstan	17	81.5	27.8	8	27
Malaysia	18	46.2	23.5	22	94
Botswana	1	31.0	–	–	–
South Africa	39	47.0	52.0	22	42
Lithuania	4	71.4	32.1	12	37
Hungary	10	73.0	25.3	11	44
Venezuela	20	15.0	23.1	35	151
Argentina	33	61.3	21.3	16	74
Uruguay	3	–	26.6	–	–
Brazil	151	–	46.1	–	–
Mexico	83	44.5	30.2	23	75
Belarus	10	76.5	23.6	10	41
Russian Federation	149	76.5	28.7	10	34
Latvia	3	78.0	–	–	–
Trinidad and Tobago	1	65.5	–	–	–
Gabon	1	–	–	–	–
Estonia	2	80.0	–	–	–
Portugal	10	74.0	22.8	11	47
Oman	2	42.9	–	–	–
Puerto Rico	4	58.8	17.7	17	95
Korea, Rep.	43	87.0	15.6	5	34
Greece	10	82.0	19.0	7	39
Saudi Arabia	15	34.0	54.2	27	50

Yugoslavia	24	61.0			
Total (countries with complete data set)	1 039	57.8	36.7	17	47

Sources: The World Bank, op.cit.: UNESCO, op.cit.

Table 22. Impact of expanding female secondary NER to 100 per cent on DALY in low-income countries (regression coefficient – 0.81)

Low-income countries	Population in millions	% enrolled	Actual DALY/1 000	DALY reduction/1 000	% of reduction
Mozambique	16	5.0	183.3	77	42
Tanzania, United Rep.	25	3.5	145.6	78	54
Ethiopia	53	11.3	139.1	72	52
Uganda	17	8.7	139.1	74	53
Bhutan	1	–	–	–	–
Guinea-Bissau	1	–	–	–	–
Nepal	19	17.4	104.8	67	64
Burundi	6	3.5	105.3	78	74
Chad	6	2.6	137.8	79	57
Madagascar	12	15.7	81.9	68	83
Sierra Leone	4	11.3	244.4	72	29
Bangladesh	111	12.0	107.9	71	66
Lao PDR	4	13.0	145.5	70	48
Malawi	9	4.3	143.0	77	54
Rwanda	7	6.0	161.2	76	47
Mali	9	4.0	140.4	78	55
Burkina Faso	9	5.0	148.2	77	52
Niger	8	3.0	157.3	79	50
India	866	28.7	94.0	58	61
Kenya	25	18.3	58.5	66	113
Nigeria	99	18.3	127.4	66	52
China	1 150	36.5	34.0	51	151
Haiti	7	17.4	122.4	67	55
Benin	5	6.1	115.7	76	66
Central African Rep.	3	6.1	96.2	76	79
Ghana	15	24.3	71.5	61	86
Pakistan	116	13.0	89.4	70	79
Togo	4	10.0	102.7	73	71
Guinea	6	4.3	162.5	77	48
Nicaragua	4	40.9	79.8	48	60
Sri Lanka	17	67.0	21.9	27	122
Mauritania	2	7.8	–	–	–
Yemen, Rep.	13	12.2	152.4	71	47
Honduras	5	32.2	47.9	55	115
Lesotho	2	20.0	–	–	–

Low-income countries	Population in millions	% enrolled	Actual DALY/1 000	DALY reduction/1 000	% of reduction
Indonesia	181	35.0	56.3	53	94
Egypt	54	64.0	48.3	29	60
Zimbabwe	10	40.0	48.1	22	46
Sudan	26	18.3	109.2	30	28
Zambia	8	18.3	111.8	30	27
Total (countries with complete data set)	2 929	29.6	71.6	57	79

Sources: The World Bank, op.cit.: UNESCO, op.cit.

Table 23. Impact of expanding female secondary NER to 100 per cent on DALY in middle-income countries (regression coefficient – 0.37)

Middle-income countries	Population in millions	% enrolled	Actual DALY/1 000	DALY reduction/1 000	% of reduction
Bolivia	7	27.0	104.7	27	26
Côte d'Ivoire	12	11.9	65.0	33	50
Senegal	8	9.3	128.7	34	26
Philippines	63	61.9	42.2	14	33
Papua New Guinea	4	8.5	123.6	34	27
Cameroon	12	19.5	87.1	30	34
Guatemala	9	21.2	72.7	29	40
Dominican Rep.	7	26.0	42.6	27	64
Ecuador	11	42.4	37.3	21	57
Morocco	26	25.4	63.0	28	44
Jordan	4	–	26.4	–	–
Tajikistan	5	62.7	35.2	14	39
Peru	22	52.0	56.8	18	31
El Salvador	5	23.0	49.7	28	57
Congo	2	37.3	–	–	–
Syrian Arab Rep.	13	39.0	36.6	23	62
Colombia	33	49.0	19.5	19	97
Paraguay	4	26.0	39.0	27	70
Uzbekistan	21	80.5	29.3	7	25
Jamaica	2	65.0	–	–	–
Romania	23	74.0	32.1	10	30
Namibia	1	41.5	–	–	–
Tunisia	8	39.0	30.8	23	73
Kyrgyzstan	4	85.6	29.3	5	18
Thailand	57	25.4	34.4	28	80
Georgia	5	74.0	22.0	10	44
Azerbaijan	7	76.3	23.4	9	37
Turkmenistan	4	–	42.5	–	–
Turkey	57	43.0	45.4	21	46
Poland	38	79.0	27.0	8	29

Middle-income countries	Population in millions	% enrolled	Actual DALY/1 000	DALY reduction/1 000	% of reduction
Bulgaria	9	65.0	25.3	13	51
Costa Rica	3	–	–	–	–
Algeria	26	48.0	39.6	19	49
Panama	2	53.0	–	–	–
Armenia	3	66.9	20.5	12	60
Chile	13	57.0	23.1	16	69
Iran, Islamic Rep.	58	68.0	46.9	12	25
Moldova	4	70.3	32.1	11	34
Ukraine	52	–	27.0	–	–
Mauritius	1	44.9	–	–	–
Czechoslovakia	16	–	27.0	–	–
Kazakhstan	17	83.9	27.8	6	21
Malaysia	18	49.2	23.5	19	80
Botswana	1	36.0	–	–	–
South Africa	39	54.0	52.0	17	33
Lithuania	4	74.6	32.1	9	29
Hungary	10	76.0	25.3	9	35
Venezuela	20	22.0	23.1	29	125
Argentina	33	68.6	21.3	12	54
Uruguay	3	–	26.6	–	–
Brazil	151	–	46.1	–	–
Mexico	83	45.8	30.2	20	67
Belarus	10	80.5	23.6	7	31
Russian Federation	149	81.4	28.7	7	24
Latvia	3	79.0	–	–	–
Trinidad and Tobago	1	69.5	–	–	–
Gabon	1	–	–	–	–
Estonia	2	86.0	–	–	–
Portugal	10	81.0	22.8	7	31
Oman	2	33.9	–	–	–
Puerto Rico	4	55.9	17.7	16	92
Korea, Rep.	43	85.0	15.6	6	35
Greece	10	83.0	19.0	6	33
Saudi Arabia	15	28.0	54.2	27	49
Yugoslavia	24	63.0	–	–	–
Total (countries with complete data set)	1 039	57.3	36.7	16	43

Sources: The World Bank, op.cit.: UNESCO, op.cit.

Table 24. Impact of expanding total secondary NER to 100 per cent on DALY in low-income countries (regression coefficient – 0.73)

Low-income countries	Population in millions	% enrolled	Actual DALY/1 000	DALY reduction/1 000	% of reduction
Mozambique	16	6.0	183.3	69	37
Tanzania, United Rep.	25	4.0	145.6	70	48
Etiopía	53	11.2	139.1	65	47
Uganda	17	10.4	139.1	65	47
Bhutan	1	–	–	–	–
Guinea-Bissau	1	–	–	–	–
Nepal	19	26.4	104.8	54	51
Burundi	6	4.8	105.3	69	66
Chad	6	6.4	137.8	68	50
Madagascar	12	14.4	81.9	62	76
Sierra Leone	4	13.6	244.4	63	26
Bangladesh	111	18.0	107.9	60	55
Lao PDR	4	15.0	145.5	62	43
Malawi	9	6.4	143.0	68	48
Rwanda	7	7.0	161.2	68	42
Mali	9	5.0	140.4	69	49
Burkina Faso	9	7.0	148.2	68	46
Niger	8	6.0	157.3	69	44
India	866	35.2	94.0	47	50
Kenya	25	19.2	58.5	59	101
Nigeria	99	20.0	127.4	58	46
China	1 150	39.2	34.0	44	131
Haiti	7	16.8	122.4	61	50
Benin	5	9.6	115.7	66	57
Central African Rep.	3	9.6	96.2	66	69
Ghana	15	28.8	71.5	52	73
Pakistan	116	18.4	89.4	60	67
Togo	4	18.0	102.7	60	58
Guinea	6	8.0	162.5	67	41
Nicaragua	4	32.0	79.8	50	62
Sri Lanka	17	59.2	21.9	30	136
Mauritania	2	11.2	–	–	–
Yemen, Rep.	13	27.2	152.4	53	35
Honduras	5	21.0	47.9	58	120
Lesotho	2	15.0	–	–	–
Indonesia	181	38.0	56.3	45	80
Egypt	54	67.0	48.3	24	50
Zimbabwe	10	40.0	48.1	44	91
Sudan	26	19.2	109.2	59	54
Zambia	8	21.6	111.8	57	51
Total (countries with complete data set)	2 929	33.5	71.6	49	68

Sources: The World Bank, op.cit.: UNESCO, op.cit.

Table 25. Impact of expanding total secondary NER to 100 per cent on DALY in middle-income countries (regression coefficient – 0.44)

Middle-income countries	Population in millions	% enrolled	Actual DALY/1 000	DALY reduction/1 000	% of reduction
Bolivia	7	29.0	104.7	31	30
Côte d'Ivoire	12	18.5	65.0	36	55
Senegal	8	13.4	128.7	38	30
Philippines	63	57.0	42.2	19	45
Papua New Guinea	4	10.1	123.6	40	32
Cameroon	12	23.5	87.1	34	39
Guatemala	9	21.8	72.7	34	47
Dominican Rep.	7	22.0	42.6	34	81
Ecuador	11	42.0	37.3	26	68
Morocco	26	29.4	63.0	31	49
Jordan	4	–	26.4	–	–
Tajikistan	5	65.5	35.2	15	43
Peru	22	53.0	56.8	21	36
El Salvador	5	22.0	49.7	34	69
Congo	2	44.5	–	–	–
Syrian Arab Rep.	13	46.0	36.6	24	65
Colombia	33	46.0	19.5	24	122
Paraguay	4	26.0	39.0	33	83
Uzbekistan	21	83.2	29.3	7	25
Jamaica	2	64.0	–	–	–
Romania	23	73.0	32.1	12	37
Namibia	1	36.0	–	–	–
Tunisia	8	43.0	30.8	25	82
Kyrgyzstan	4	84.0	29.3	7	24
Thailand	57	25.2	34.4	33	96
Georgia	5	74.0	22.0	11	52
Azerbaijan	7	75.6	23.4	11	46
Turkmenistan	4	–	42.5	–	–
Turkey	57	51.0	45.4	22	47
Poland	38	76.0	27.0	11	39
Bulgaria	9	63.0	25.3	16	64
Costa Rica	3	–	–	–	–
Algeria	26	54.0	39.6	20	51
Panama	2	51.0	–	–	–
Armenia	3	75.6	20.5	11	52
Chile	13	55.0	23.1	20	86
Iran, Islamic Rep.	58	71.0	46.9	13	27
Moldova	4	67.2	32.1	14	45
Ukraine	52	78.2	27.0	10	36

Middle-income countries	Population in millions	% enrolled	Actual DALY/1 000	DALY reduction/1 000	% of reduction
Mauritius	1	44.5	–	–	–
Czechoslovakia	16	–	27.0	–	–
Kazakhstan	17	82.4	27.8	8	28
Malaysia	18	47.1	23.5	23	99
Botswana	1	34.0	–	–	–
South Africa	39	51.0	52.0	22	41
Lithuania	4	72.3	32.1	12	38
Hungary	10	75.0	25.3	11	43
Venezuela	20	19.0	23.1	36	155
Argentina	33	64.7	21.3	16	73
Uruguay	3	68.1	26.6	14	53
Brazil	151	15.0	46.1	37	81
Mexico	83	45.0	30.2	24	80
Belarus	10	78.2	23.6	10	41
Russian Federation	149	78.2	28.7	10	34
Latvia	3	79.0	–	–	–
Trinidad and Tobago	1	67.2	–	–	–
Gabon	1	–	–	–	–
Estonia	2	83.0	–	–	–
Portugal	10	78.0	22.8	10	42
Oman	2	38.7	–	–	–
Puerto Rico	4	57.1	17.7	19	106
Korea, Rep.	43	86.0	15.6	6	39
Greece	10	83.0	19.0	7	39
Saudi Arabia	15	31.0	54.2	30	56
Yugoslavia	24	62.0	–	–	–
Total (countries with complete data set)	1 245	52.9	37.5	21	55

Sources: The World Bank, op.cit.: UNESCO, op.cit.

Table 26. Association between estimated net primary education enrolment and total disability adjusted life years per 1,000 population, by age group and for all ages, examining data for demographic regions

Age	All ages				0-5-year-olds				5-14-year-olds			
Education	β	β#	SE	p	β	β#	SE	p	β	β#	SE	p
Male	-9.53	-6.43	3.63		-33.51	-22.58	12.54		-4.70	-1.47	1.69	
Female	-9.65	-7.54	1.37	**	-34.26	-24.90	7.43	*	-4.87	-2.16	0.87	
Total	-11.48	-10.09	1.46	**	-40.72	-33.2	5.56	**	-5.84	-3.51	0.96	*
Age	15-44-year-olds				45-59-years-olds				60+-year-olds			
Education	β	β#	SE	p	β	β#	SE	p	β	β#	SE	p
Male	-4.83	-2.07	2.67		-3.50	-1.90	1.71		-3.19	-1.64	1.31	
Female	-5.14	-3.36	1.30		-3.97	-2.40	1.08		-4.19	-1.73	1.11	
Total	-6.13	-4.73	1.70	*	-4.49	-3.75	1.35	*	-4.42	-2.83	1.26	

B = crude regression coefficient; b# = regression coefficient adjusted for log of GNP and secondary education enrolment; b& = regression coefficient adjusted for log of GNP and primary education enrolment; SE = standard error; p = ≤ 0.05; ** p = ≤ 0.01.

Data source on DALY and GNP: The World Bank, op.cit.
Data source on gross education enrolment: UNESCO: *The right to education: Towards education for all throughout life,* Paris, 2000.

Table 27. Association between estimated net secondary education enrolment and total disability adjusted life years per 1,000 population, by age group and for all ages, examining data for demographic regions

Age	All ages				0-5-year-olds				5-14-year-olds			
Education	β	β#	SE	P	β	β#	SE	p	β	β#	SE	p
Male	-6.17	-3.29	2.58		-23.09	-11.92	8.91		-3.77	-3.28	1.20	*
Female	-5.31	-2.69	1.20		-20.14	-10.43	6.49		-3.25	-3.17	0.76	*
Total	-4.64	-1.04	0.89		-18.04	-5.48	3.39		-2.97	-1.92	0.59	*
Age	15-44-year-olds				45-59-year-olds				60+-year-olds			
Education	β	β#	SE	p	β	β#	SE	p	β	β#	SE	p
Male	-3.39	-2.76	1.89		-2.86	-1.73	1.21		-3.50	-1.89	0.93	
Female	-2.93	-2.35	1.14		-2.61	-1.56	0.94		-3.41	-1.88	0.97	
Total	-2.61	-1.19	1.04		-2.11	-0.46	0.83		-2.79	-0.94	0.77	

B = crude regression coefficient; b# = regression coefficient adjusted for log of GNP and secondary education enrolment; b& = regression coefficient adjusted for log of GNP and primary education enrolment; SE = standard error; p = ≤ 0.05; ** p = ≤ 0.01.

Data source on DALY and GNP: The World Bank, op.cit.
Data source on gross education enrolment: UNESCO: *The right to education: Towards education for all throughout life,* Paris, 2000.

Table 28. Association between estimated net primary education enrolment and male disability adjusted life years per 1,000 population, by age group and for all ages, examining data for demographic regions

Age	All ages				0-5-year-olds				5-14-year-olds			
Education	β	β#	SE	p	β	β#	SE	p	β	β#	SE	p
Male	-9.73	-6.04	3.94		-35.43	-21.49	12.70		-4.88	-1.06	1.68	
Female	-9.70	-7.45	1.48	**	-35.48	-24.61	6.72	**	-4.93	-1.80	0.90	
Total	-11.63	-10.19	1.97	**	-42.67	-33.81	5.06	**	-6.00	-3.26	1.09	*
Age	**15-44-year-olds**				**45-59-year-olds**				**60+-year-olds**			
Education	β	β#	SE	p	β	β#	SE	p	β	β#	SE	p
Male	-4.54	-1.44	3.08		-3.47	-2.51	2.61		-2.11	-1.63	1.09	
Female	-4.76	-2.97	1.85		-3.86	-2.95	2.01		-2.97	-1.52	1.01	
Total	-5.75	-4.41	2.34		-4.31	-4.51	2.22		-2.95	-2.47	1.14	

B = crude regression coefficient; b# = regression coefficient adjusted for log of GNP and secondary education enrolment; b& = regression coefficient adjusted for log of GNP and primary education enrolment; SE = standard error; p = ≤ 0.05; ** p = ≤ 0.01.

Data source on DALY and GNP: The World Bank, op.cit.
Data source on gross education enrolment: UNESCO: *The right to education: Towards education for all throughout life,* Paris, 2000.

Table 29. Association between estimated net secondary education enrolment and male disability adjusted life years per 1,000 population, by age group and for all ages, examining data for demographic regions

Age	All ages				0-5-year-olds				5-14-year-olds			
Education	β	β#	SE	p	β	β#	SE	p	β	β#	SE	p
Male	-6.17	-3.78	2.80		-24.17	-14.62	9.02		-3.95	-3.82	1.19	*
Female	-5.21	-3.13	1.29		-20.69	-13.10	5.87		-3.34	-3.76	0.79	**
Total	-4.55	-1.18	1.20		-18.72	-7.01	3.08		-3.10	-2.30	0.66	*
Age	**15-44-year-olds**				**45-59-year-olds**				**60+-year-olds**			
Education	β	β#	SE	p	β	β#	SE	p	β	β#	SE	p
Male	-3.11	-3.02	2.19		-2.53	-1.12	1.86		-2.42	-0.81	0.77	
Female	-2.62	-2.58	1.62		-2.31	-0.86	1.76		-2.45	-0.79	0.88	
Total	-2.33	-1.23	1.43		-1.69	0.34	1.35		-1.83	-0.03	0.70	

B = crude regression coefficient; b# = regression coefficient adjusted for log of GNP and secondary education enrolment; b& = regression coefficient adjusted for log of GNP and primary education enrolment; SE = standard error; p = ≤ 0.05; ** p = ≤ 0.01.

Data source on DALY and GNP: The World Bank, op.cit.
Data source on gross education enrolment: UNESCO: *The right to education: Towards education for all throughout life,* Paris, 2000.

Table 30. Association between estimated net primary education enrolment and female disability adjusted life years per 1,000 population, by age group and for all ages, examining data for demographic regions

Age	All ages				0-5-year-olds				5-14-year-olds			
Education	β	β#	SE	p	β	β#	SE	p	β	β#	SE	p
Male	-9.32	-6.90	3.49		-31.58	-23.72	12.54		-4.51	-1.90	1.72	
Female	-9.62	-7.74	1.53	**	-33.06	-25.24	8.22	*	-4.79	-2.52	0.88	*
Total	-11.31	-10.09	1.25	**	-38.78	-32.79	6.39	**	-5.67	-3.75	0.85	*
Age	**15-44-year-olds**				**45-59-year-olds**				**60+-year-olds**			
Education	β	β#	SE	p	β	β#	SE	p	β	β#	SE	p
Male	-5.13	-2.75	2.44		-3.57	-1.39	1.32		-3.99	-1.90	1.69	
Female	-5.55	-3.80	1.02	*	-4.13	-1.99	0.46	*	-5.06	-2.17	1.30	
Total	-6.52	-5.11	1.21	*	-4.72	-3.16	0.77	*	-5.45	-3.42	1.47	

B = crude regression coefficient; b# = regression coefficient adjusted for log of GNP and secondary education enrolment; b& = regression coefficient adjusted for log of GNP and primary education enrolment; SE = standard error; p = ≤ 0.05; ** p = ≤ 0.01.

Data source on DALY and GNP: The World Bank, op.cit.
Data source on gross education enrolment: UNESCO: *The right to education: Towards education for all throughout life,* Paris, 2000.

Table 31. Association between estimated net secondary education enrolment and female disability adjusted life years per 1,000 population, by age group and for all ages, examining data for demographic regions

Age	All ages				0-5-year-olds				5-14-year-olds			
Education	β	β#	SE	p	β	β#	SE	p	β	β#	SE	p
Male	-6.14	-2.70	2.48		-22.03	-9.18	8.91		-3.57	-2.70	1.22	
Female	-5.38	-2.14	1.33		-19.63	-7.71	7.18		-3.13	-2.55	0.77	*
Total	-4.70	-0.81	0.76		-17.40	-3.93	3.90		-2.83	-1.52	0.52	*
Age	**15-44-year-olds**				**45-59-year-olds**				**60+-year-olds**			
Education	β	β#	SE	p	β	β#	SE	p	β	β#	SE	p
Male	-3.68	-2.48	1.73		-3.16	-2.33	0.94		-4.14	-2.44	1.20	
Female	-3.25	-2.09	0.89		-2.89	-2.19	0.41	**	-3.98	-2.40	1.13	
Total	-2.90	-1.12	0.74		-2.48	-1.14	0.47		-3.33	-1.30	0.90	

B = crude regression coefficient; b# = regression coefficient adjusted for log of GNP and secondary education enrolment; b& = regression coefficient adjusted for log of GNP and primary education enrolment; SE = standard error; p = ≤ 0.05; ** p = ≤ 0.01.

Data source on DALY and GNP: The World Bank, op.cit.
Data source on gross education enrolment: UNESCO: *The right to education: Towards education for all throughout life,* Paris, 2000.

Table 32. Impact of expanding estimated male primary NER to 100 per cent on DALY by demographic region (regression coefficient – 6.43)

Demographic region*	Population in millions	% enrolled	Actual DALY/1 000	DALY reduction/1 000	% of reduction
Sub-Saharan Africa	419	66	574	219	38
India	866	88	344	77	22
China	1 150	99	178	6	4
Other Asia	526	90	259	64	25
Latin America and the Caribbean	421	93	232	45	19
North Africa, Middle East and Central Asia	461	70	287	193	67
Central and Eastern Europe	315	90	168	64	38
Developed countries	803	97	117	19	16
Central and Eastern Europe and developed countries	1 118	95	133	32	24
Developing countries	3 843	80	294	129	44
World	4 961	83	259	109	42

*See table 2 for a list of countries.

Sources: The World Bank, op.cit.: UNESCO, op.cit.

Table 33. Impact of expanding estimated female primary NER to 100 per cent on DALY by demographic region (regression coefficient – 7.54)

Demographic region*	Population in millions	% enrolled	Actual DALY/1 000	DALY reduction/1 000	% of reduction
Sub-Saharan Africa	419	55	574	339	59
India	866	69	344	234	68
China	1 150	95	178	38	21
Other Asia	526	85	259	113	44
Latin America and the Caribbean	421	91	232	68	29
North Africa, Middle East and Central Asia	461	85	287	113	39
Central and Eastern Europe	315	90	168	75	45
Developed countries	803	96	117	30	26
Central and Eastern Europe and developed countries	1 118	95	133	38	28
Developing countries	3 843	89	294	83	28
World	4 961	90	259	75	29

*See table 2 for a list of countries.

Sources: The World Bank, op.cit.: UNESCO, op.cit.

Table 34. Impact of expanding estimated total primary NER to 100 per cent on DALY by demographic region (regression coefficient – 10.09)

Demographic region*	Population in millions	% enrolled	Actual DALY/1 000	DALY reduction/1 000	% of reduction
Sub-Saharan Africa	419	61	574	394	69
India	866	79	344	212	62
China	1 150	97	178	30	17
Other Asia	526	88	259	121	47
Latin America and the Caribbean	421	88	232	121	52
North Africa, Middle East and Central Asia	461	78	287	222	77
Central and Eastern Europe	315	92	168	81	48
Developed countries	803	97	117	30	26
Central and Eastern Europe and developed countries	1 118	95	133	50	38
Developing countries	3 843	84	294	161	55
World	4 961	87	259	131	51

*See table 2 for a list of countries.

Sources: The World Bank, op.cit.: UNESCO, op.cit.

Table 35. Impact of expanding estimated male secondary NER to 100 per cent on DALY by demographic region (regression coefficient – 3.28)

Demographic region*	Population in millions	% enrolled	Actual DALY/1 000	DALY reduction/1 000	% of reduction
Sub-Saharan Africa	419	21	574	259	45
India	866	45	344	180	52
China	1 150	46	178	177	100
Other Asia	526	41	259	194	75
Latin America and the Caribbean	421	45	232	180	78
North Africa, Middle East and Central Asia	461	44	287	184	64
Central and Eastern Europe	315	65	168	115	68
Developed countries	803	86	117	46	39
Central and Eastern Europe and developed countries	1 118	84	133	52	39
Developing countries	3 843	34	294	216	74
World	4 961	45	259	180	70

*See table 2 for a list of countries.

Sources: The World Bank, op.cit.: UNESCO, op.cit.

Table 36. Impact of expanding estimated female secondary NER to 100 per cent on DALY by demographic region (regression coefficient – 2.69)

Demographic region*	Population in millions	% enrolled	Actual DALY/1 000	DALY reduction/1 000	% of reduction
Sub-Saharan Africa	419	17	574	223	39
India	866	28	344	194	56
China	1 150	36	178	172	97
Other Asia	526	37	259	169	65
Latin America and the Caribbean	421	42	232	156	67
North Africa, Middle East and Central Asia	461	54	287	124	43
Central and Eastern Europe	315	62	168	102	61
Developed countries	803	83	117	46	39
Central and Eastern Europe and developed countries	1 118	81	133	51	38
Developing countries	3 843	43	294	153	52
World	4 961	51	259	132	51

*See table 2 for a list of countries.

Sources: The World Bank, op.cit.: UNESCO, op.cit.

Table 37. Impact of expanding estimated total secondary NER to 100 per cent on DALY by demographic region (regression coefficient – 1.04)

Demographic region*	Population in millions	% enrolled	Actual DALY/1 000	DALY reduction/1 000	% of reduction
Sub-Saharan Africa	419	18	574	85	15
India	866	35	344	68	20
China	1 150	39	178	63	36
Other Asia	526	39	259	63	24
Latin America and the Caribbean	421	33	232	70	30
North Africa, Middle East and Central Asia	461	49	287	53	18
Central and Eastern Europe	315	77	168	24	14
Developed countries	803	86	117	15	12
Central and Eastern Europe and developed countries	1 118	84	133	17	13
Developing countries	3 843	36	294	67	23
World	4 961	47	259	55	21

*See table 2 for a list of countries.

Sources: The World Bank, op.cit.: UNESCO, op.cit.

Table 38. Hazardous industries, occupations, activities and agents most frequently cited in national legislation on child labour

Prohibited industries and occupations	No. of countries
Mining, quarries, underground work	101
Maritime work (trimmers and stokers)	57
Machinery in motion (operating, cleaning, repairs, etc)	57
Weights and load	40
Construction and/or demolition	37
Circular saws and other dangerous machinery	35
Lead/zinc metallurgy	34
Transport, operating vehicles	33
Entertainment	32
Alcohol production and/or sale	29
Cranes/hoists/lifting machinery	23
Crystal and/or glass manufacture	22
Welding and smelting of metals	20
Agriculture (specified tasks only)	14
Abattoirs and meat rendering	14
Underwater work	13
Street trades	12
Production of pornographic material	10
Tanneries	12
Textile industry (specified tasks)	5
Metal and wood handicraft (different tasks incl. carpentry, slate-pencil production, precious stone work)	7
Forestry	6
Brick manufacture	5
Prohibited agents	
Explosives (manufacturing and handling)	50
Fumes, dust, gas and other noxious substances	35
Radioactive substances or ionizing radiation	29
Chemicals, general provisions for exposure to	26
Pathogenic agents, exposure to (hospital work, city cleaning, work related to sewers, handling of corpses)	18
Electricity	15
Paints, solvents, shellac, varnish, glue or enamel	9
Asbestos	8
Benzene	5

Source: ILO: Child labour: Targeting the intolerable. Geneva: International Labour Office, 1998.

Table 39. Percentage of child workers by age in the major industry divisions

Major industry division	5-14-year-olds	15-17-year-olds	
	26 developing countries*	Brazil**	USA***
Agriculture	70.4	12.4	8.0
Mining	0.9	–	–
Manufacturing	8.3	21.8	3.6
Construction	1.9	7.9	2.5
Retail	8.3	17.3	51.8
Services	10.3	28.2	25.9
Others	–	12.4	8.2

Sources: * ILO: Statistics on Working Children and Hazardous Child Labour in Brief, 1998. ** Fausto A, Cervini R. O Trabalho e a Rua: Crianças e adolescentes no Brasil urbano dos anos 80. São Paulo, SP: Cortez Editora, 1996. *** Committee on the Health and Safety Implications of Child Labour. Protecting youth at work: Health, safety, and development of working children and adolescents in the United States, Washington, DC, 1998.

Table 40. The world map of child soldiers

Child soldiers fighting in recent and ongoing conflicts	
Colombia	P, O
Mexico	P, O
Peru	O
Russian Federation	O
Turkey	O
Yugoslavia (former Rep. of)	P, O
Algeria	P, O
Angola	G, O
Burundi	G, O
Chad	G
Republic of Congo	G, O
Dem. Rep. of the Congo	G, O
Eritrea	G
Ethiopia	G
Rwanda	G, O
Sierra Leone	G, P, O
Somalia	G, P, O
Sudan	G, P, O
Uganda	G, O
Iran	G, O
Iraq	G, O
Israel and occupied territories	G, O
Lebanon	O
Afghanistan	G, P, O
India	P, O
Indonesia	P, O
Myanmar	G, O

Child soldiers fighting in recent and ongoing conflicts	
Nepal	O
Pakistan	O
Philippines	O
Solomon Islands	O
Sri Lanka	O
East Timor	P, O
Tajikistan	O
Papua New Guinea	O
Uzbekistan	O

G: Government armed forces; P: Paramilitaries; O: Armed opposition groups.

Source: Human Rights Watch: Stop the use of child soldiers. http://www.hrw.org/campaigns/crp/where.htm .

Table 41. Best estimates for injury fatality rates by major industry division

Major industry division and age group	Age	Fatality rate
Agriculture	5-14	13.7 per 100 000 workers
	15-17	16.8 per 100 000 workers
Mining	5-17	32 per 100 000 FTE
Construction	5-17	15 per 100 000 FTE
Manufacturing	5-17	4 per 100 000 FTE
Services	5-17	3 per 100 000 FTE
Retail	5-17	3 per 100 000 FTE

Sources: Kisner SM, Fosbroke DE. 1994. Injury hazards in the construction industry. J Occup Med 36: 137-143. Committee on Environmental Health – American Academy of Pediatrics. 1995. The hazards of child labor. Pediatrics 95: 311-313.

Table 42. YLL per 100,000 workers per year by major industry division and age (fatality rate times YLL per fatal injury)

Major industry division and age group	Fatality rate per 100 000	YLL per fatal injury	YLL per 100 000 workers per year
Agriculture			
5-14-year-olds	13.7	37.47	513.34 per 100 000 workers
15 to 17years-old	16.8	36.80	618.24 per 100 000 workers
Mining			
5-14-year-olds	32	37.47	1 199.04 per 100 000 FTE
15-17-year-olds	32	36.80	1 167.60 per 100 000 FTE
Construction			
5-14-year-olds	15	37.47	562.05 per 100 000 FTE
15-17-year-olds	15	36.80	552.00 per 100 000 FTE
Manufacturing			
5-14-year-olds	4	37.47	149.88 per 100 000 FTE
15-17-year-olds	4	36.80	147.20 per 100 000 FTE
Services and retail			
5-14-year-olds	3	37.47	112.41 per 100 000 FTE
15-17-year-olds	3	36.80	110.40 per 100 000 FTE

Sources: S.M. Kisner, D.E. Fosbroke. 1994. Injury hazards in the construction industry. J Occup Med 36: 137-143. Committee on Environmental Health – American Academy of Pediatrics. 1995. The hazards of child labor. Pediatrics 95: 311-313. C. Murray, A. Lopez,. 1996. The Global Burden of Disease. Boston: Harvard School of Public Health.

Table 43. YLD for each cut, laceration and puncture by age

Age	Average age of onset	Disability weight	Duration of disability	YLD
5-14-year-olds	10	0.108	0.024	0.002882
15-17-year-olds	16	0.108	0.024	0.003625

Source: C. Murray, A. Lopez, 1996. The Global Burden of Disease. Boston: Harvard School of Public Health.

Table 44. YLD for each contusion, concussion and bruises by age

Age	Average age of onset	Disability weight	Duration of disability	YLD
5-14-year-olds	10	0.108	0.024	0.002882
15-17-year-olds	16	0.108	0.024	0.003625

Source: C. Murray, A. Lopez, 1996. The Global Burden of Disease. Boston: Harvard School of Public Health.

Table 45. YLD for each sprain and strain by age

Age	Average age of onset	Disability weight	Duration of disability	YLD
5-14-year-olds	10	0.064	0.038	0.002704
15-17-year-olds	16	0.064	0.038	0.003401

Source: C. Murray, A. Lopez, 1996. The Global Burden of Disease. Boston: Harvard School of Public Health.

Table 46. YLD for each severity of burn by age

Age	Average age of onset	Disability weight	Duration of disability	YLD
5-14-year-olds				
< 20% short-term	10	0.158	0.083	0.014593
> 20% short-term	10	0.441	0.279	0.137301
15-17-year-olds				
<20% short-term	16	0.158	0.083	0.018338
>20% short-term	16	0.441	0.279	0.171919

* life expectancy at age 10; ** life expectancy at age 15.

Source: C. Murray, A. Lopez, 1996. The Global Burden of Disease. Boston: Harvard School of Public Health.

Table 47. YLD for each burn, weighted for the prevalence of severity of burn by age

Severity and age group	YLD	%	Weighted YLD
5-14-year-olds			
< 20% short-term	0.014593	70.0	0.010215
> 20% short-term	0.137301	30.0	0.041190
Total	–	100.0	0.051405
15-17-year-olds			
< 20% short-term	0.018338	70.0	0.012837
> 20% short-term	0.171919	30.0	0.051576
Total	–	100.0	0.064412

Sources: C. Murray, A. Lopez, 1996. The Global Burden of Disease. Boston: Harvard School of Public Health. D.L.Parker, W.R. Carl, L.R. French, F.B.Martin, 1994. Nature and Incidence of self-reported adolescent work injury in Minnesota. Am J Ind Med 26: 529-541.

Table 48. YLD for fractures in each body site by age

Body site and age group	Disability weight	Duration of disability	YLD
5-14-year-olds (average age of onset 10 years old)			
Fracture hand bones	0.100	0.070	0.007788
Fracture radius or ulna	0.180	0.112	0.022443
Fracture clavicle, scapula, or humerus: short-term	0.153	0.112	0.019076
Fracture bones in foot: short-term	0.077	0.073	0.006254
Fracture femur lifelong	0.272	70.40*	10.19181
Fracture patella, tibia, or fibula short-term	0.271	0.090	0.027143
15-17-year-olds (average age of onset 16 years old)			
Fracture hand bones	0.100	0.070	0.009789
Fracture radius or ulna	0.180	0.112	0.028188
Fracture clavicle, scapula, or humerus: short-term	0.153	0.112	0.02396
Fracture bones in foot: short-term	0.077	0.073	0.00786
Fracture femur lifelong	0.272	65.41**	9.95452
Fracture patella, tibia, or fibula short-term	0.271	0.090	0.034105

* life expectancy at age 10; ** life expectancy at age 15.

Source: C. Murray, A. Lopez, 1996. The Global Burden of Disease. Boston: Harvard School of Public Health.

Table 49. YLD for each fracture, weighted for the prevalence of fracture in each body site

Body site and age group	YLD	%	Weighted YLD
5-14-year-olds			
Fracture hand bones	0.007788	39.4	0.003068
Fracture radius or ulna	0.022443	22.0	0.004937
Fracture clavicle, scapula, or humerus: short-term	0.019076	4.6	0.000877
Fracture bones in foot: short-term	0.006254	10.7	0.000669
Fracture femur lifelong	10.19181	8.1	0.825537
Fracture patella, tibia, or fibula short-term	0.027143	14.8	0.004017
Total	–	100.0	0.839105
15-17-year-olds			
Fracture hand bones	0.009789	39.4	0.003857
Fracture radius or ulna	0.028188	22.0	0.006201
Fracture clavicle, scapula, or humerus: short-term	0.02396	4.6	0.001102
Fracture bones in foot: short-term	0.00786	10.7	0.000841
Fracture femur lifelong	9.95452	8.1	0.806316
Fracture patella, tibia, or fibula short-term	0.034105	14.8	0.005048
Total	–	100.0	0.823365

Sources: C. Murray, A. Lopez, 1996. The Global Burden of Disease. Boston: Harvard School of Public Health. D.L.Parker, W.R. Carl, L.R. French, F.B.Martin, 1994. Nature and Incidence of self-reported adolescent work injury in Minnesota. Am J Ind Med 26: 529-541.

Table 50. YLD for amputation in each body site by age

Body site and age group	Disability weight	Duration of disability	YLD
5-14-year-olds (average age of onset 10 years old)			
Amputated finger: lifelong	0.102	70.40*	3.821929
Amputated arm: lifelong	0.257	70.40*	9.629763
15-17-year-olds (average age of onset 16 years old)			
Amputated finger: lifelong	0.102	65.41**	3.732945
Amputated arm: lifelong	0.257	65.41**	9.405557

* life expectancy at age 10; ** life expectancy at age 15.

Source: C. Murray, A. Lopez, 1996. The Global Burden of Disease. Boston: Harvard School of Public Health.

Table 51. YLD for each amputation weighted for the prevalence of amputation in each body site

Body site and age group	Partial YLD	per cent	Weighted YLD
5-14-year-olds			
Amputated finger: lifelong	3.821929	86.0	3.286859
Amputated arm: lifelong	9.629763	14.0	1.348167
Total	–	100.0	4.635026
15-17-year-olds			
Amputated finger: lifelong	3.732945	86.0	3.210333
Amputated arm: lifelong	9.405557	14.0	1.316778
Total	–	100.0	4.527111

Sources: C. Murray, A. Lopez, 1996. The Global Burden of Disease. Boston: Harvard School of Public Health. D.L.Parker, W.R. Carl, L.R. French, F.B.Martin, 1994. Nature and Incidence of self-reported adolescent work injury in Minnesota. Am J Ind Med 26: 529-541.

Table 52. YLD for each injury in agriculture, weighted for the prevalence of each nature of injury by age

Nature of injury and age group	YLD	per cent	Weighted YLD
5-14-year-olds			
Cut, laceration, puncture	0.002882	35.6	0.001026
Contusion, concussion, bruise	0.002882	14.9	0.000429
Sprain, strain	0.002704	7.9	0.000214
Burn	0.051405	0.7	0.000360
Fracture	0.839105	14.4	0.120831
Amputation	4.635026	0.2	0.009270
Subtotal	–	73.7	0.132130
Others	–	26.3	0.047151
Total	–	100.0	0.179281
15-17-year-olds			
Cut, laceration, puncture	0.003625	35.6	0.001291
Contusion, concussion, bruise	0.003625	14.9	0.000540
Sprain, strain	0.003401	7.9	0.000269
Burn	0.064412	0.7	0.000451
Fracture	0.823365	14.4	0.118565

Nature of injury and age group	YLD	per cent	Weighted YLD
15-17-year-olds			
Amputation	4.527111	0.2	0.009054
Subtotal	–	73.7	0.130169
Others	–	26.3	0.046451
Total	–	100.0	0.176620

Sources: Table 50; L.A. Layne, D.N. Castillo, N. Stout, P. Cutlip P, 1994. Adolescent occupational injuries requiring hospital emergency department treatment: a nationally representative sample. Am J Public Health 84:657-660.

Table 53. YLD for each injury in construction weighted for the prevalence of each nature of injury by age

Nature of injury and age group	YLD	per cent	Weighted YLD
5-14-year-olds			
Cut, laceration, puncture	0.002882	27.4	0.00079
Contusion, concussion, bruise	0.002882	14.5	0.000418
Sprain, strain	0.002704	18.8	0.000508
Burn	0.051405	–	–
Fracture	0.839105	15.4	0.129222
Amputation	4.635026	–	–
Subtotal	–	76.1	0.130938
Others	–	23.9	0.041123
Total	–	100.0	0.172061
15-17-year-olds			
Cut, laceration, puncture	0.003625	27.4	0.000993
Contusion, concussion, bruise	0.003625	14.5	0.000526
Sprain, strain	0.003401	18.8	0.000639
Burn	0.064412	–	–
Fracture	0.823365	15.4	0.126798
Amputation	4.527111	–	–
Subtotal	–	76.1	0.128956
Others	–	23.9	0.0405
Total	–	100.0	0.169457

Sources: Table 50; D.R. Brooks, L.K. Davis, 1996. Work-related injuries to Massachusetts teens, 1987-90. Am J Ind Med 29: 153-160.

Table 54. YLD for each injury in manufacturing weighted for the prevalence of each nature of injury by age

Nature of injury and age group	YLD	per cent	Weighted YLD
5-14-year-olds			
Cut, laceration, puncture	0.002882	20.8	0.000599
Contusion, concussion, bruise	0.002882	10.0	0.000288
Sprain, strain	0.002704	32.3	0.000873
Burn	0.051405	7.5	0.003855
Fracture	0.839105	2.9	0.024334
Amputation	4.635026	0.2	0.009270
Subtotal	–	73.7	0.039221
Others	–	26.3	0.013996
Total	–	100.0	0.053216
15-17-year-olds			
Cut, laceration, puncture	0.003625	20.8	0.000754
Contusion, concussion, bruise	0.003625	10.0	0.000363
Sprain, strain	0.003401	32.3	0.001099
Burn	0.064412	7.5	0.004831
Fracture	0.823365	2.9	0.023878
Amputation	4.527111	0.2	0.009054
Subtotal	–	73.7	0.039978
Others	–	26.3	0.014266
Total	–	100.0	0.054244

Sources: Table 50: L.A. Layne, D.N. Castillo, N. Stout, P. Cutlip, 1994. Adolescent occupational injuries requiring hospital emergency department treatment: a nationally representative sample. Am J Public Health 84:657-660.

Table 55. YLD for each injury in retail weighted for the prevalence of each nature of injury by age

Nature of injury and age group	YLD	per cent	Weighted YLD
5-14-year-olds			
Cut, laceration, puncture	0.002882	39.0	0.001124
Contusion, concussion, bruise	0.002882	13.5	0.000389
Sprain, strain	0.002704	15.9	0.000430
Burn	0.051405	17.7	0.009099
Fracture	0.839105	3.8	0.031886
Amputation	4.635026	0.2	0.009270
Subtotal	–	90.1	0.052198
Others	–	9.9	0.005735
Total	–	100.0	0.057933
15-17-year-olds			
Cut, laceration, puncture	0.003625	39.0	0.001414
Contusion, concussion, bruise	0.003625	13.5	0.000489
Sprain, strain	0.003401	15.9	0.000541

Nature of injury and age group	YLD	per cent	Weighted YLD
Burn	0.064412	17.7	0.011401
Fracture	0.823365	3.8	0.031288
Amputation	4.527111	0.2	0.009054
Subtotal	–	90.1	0.054187
Others	–	9.9	0.005954
Total	–	100.0	0.060141

Sources: Table 50: L.A. Layne, D.N. Castillo, N. Stout, P. Cutlip, 1994. Adolescent occupational injuries requiring hospital emergency department treatment: a nationally representative sample. Am J Public Health 84:657–660.

Table 56. YLD for each injury in service weighted for the prevalence of each nature of injury by age

Nature of injury and age group	YLD	per cent	Weighted YLD
5-14-year-olds			
Cut, laceration, puncture	0.002882	23.1	0.000666
Contusion, concussion, bruise	0.002882	30	0.000865
Sprain, strain	0.002704	16.4	0.000443
Burn	0.051405	9.1	0.004678
Fracture	0.839105	2.8	0.023495
Amputation	4.635026	–	–
Subtotal	–	81.4	0.030147
Others	–	18.6	0.006889
Total	–	100	0.037035
15-17-year-olds			
Cut, laceration, puncture	0.003625	23.1	0.000837
Contusion, concussion, bruise	0.003625	30	0.001088
Sprain, strain	0.003401	16.4	0.000558
Burn	0.064412	9.1	0.005861
Fracture	0.823365	2.8	0.023054
Amputation	4.527111	–	–
Subtotal	–	81.4	0.031398
Others	–	18.6	0.007175
Total	–	100	0.038573

Sources: Table 50: L.A. Layne, D.N. Castillo, N. Stout, P. Cutlip, 1994. Adolescent occupational injuries requiring hospital emergency department treatment: a nationally representative sample. Am J Public Health 84:657–660.

Table 57. Comparison between the median and Layne LA et al. (1994) estimate for non-fatal injury incidence rate

Major industry division	Median*	Layne et al (1994) estimate	
Agriculture	1.50	4.3	per 100 FTE workers
Construction	4.80	4.8	per 100 FTE workers
Manufacturing	4.05	5.1	per 100 FTE workers
Services	2.85	4.1	per 100 FTE workers
Retail	4.17	6.3	per 100 FTE workers

* The estimated median took into account all the fatality studies included in table 72.

Sources: Table 50: L.A. Layne, D.N. Castillo, N. Stout, P. Cutlip, 1994. Adolescent occupational injuries requiring hospital emergency department treatment: a nationally representative sample. Am J Public Health 84:657–660.

Table 58. YLD per 100 FTE workers per year by major industry division and age (non-fatal injury rate per 100 FTE workers times YLD per non-fatal injury)

Major industry division and age group	Non-fatal injury rate per 100 FTE workers	YLD per non-fatal injury	YLD per 100 FTE workers per year	
Agriculture				
5-14-year-olds	4.3	0.179281	0.770908	per 100 FTE workers
15 to 17years-old	4.3	0.176620	0.759466	per 100 FTE workers
Mining				
5-14-year-olds	8.2	0.179281*	1.470104	per 100 FTE workers
15-17-year-olds	8.2	0.176620*	1.448284	per 100 FTE workers
Construction				
5-14-year-olds	4.8	0.172061	0.825893	per 100 FTE workers
15-17-year-olds	4.8	0.169457	0.813394	per 100 FTE workers
Manufacturing				
5-14-year-olds	5.1	0.053216	0.271402	per 100 FTE workers
15-17-year-olds	5.1	0.054244	0.276644	per 100 FTE workers
Service				
5-14-year-olds	4.1	0.037035	0.151844	per 100 FTE workers
15-17-year-olds	4.1	0.038573	0.158149	per 100 FTE workers
Retail				
5-14-year-olds	6.3	0.057933	0.364978	per 100 FTE workers
15-17-year-olds	6.3	0.060141	0.378888	per 100 FTE workers

* Due to the impossibility of estimating YLD per non-fatal injury for mining the highest YLD per non-fatal injury found in the others major industry divisions has been used (YLD per non-fatal injury for agriculture).

Sources: Table 50: L.A. Layne, D.N. Castillo, N. Stout, P. Cutlip, 1994. Adolescent occupational injuries requiring hospital emergency department treatment: a nationally representative sample. Am J Public Health 84:657–660. S. Schober, J. Handke, W. Halperin, M. Moll, M. Thun, 1988. Work-related injuries in minors. Am J Ind. Med 14:585-595.

Table 59. Conversion of YLL per 100,000 workers for YLL per 100,000 FTE workers per year in agriculture

Age group	YLL per 100 000 workers per year		YLL per 100 000 FTE per year	
5-14-year-olds	513.34	per 100 000 workers	743.97	per 100 000 FTE
15-17-year-olds	618.24	per 100 000 workers	686.93	per 100 000 FTE

Source for conversion rates: ILO. 1998. Statistics on Working Children and Hazardous Child Labour in Brief. A. Fausto, R. Cervini. 1996. *O Trabalho e a Rua: Crianças e adolescentes no Brasil urbano dos anos 80 São Paulo*, SP: Cortez Editora.

Table 60. DALY estimates by major industry division and age (sum of YLL and YLD)

	YLL per 100 FTE workers per year	YLD per 100 FTE workers per year	DALY per 100 FTE workers per year
Agriculture			
5-14-year-olds	0.74397	0.770908	1.514878
15-17-year-olds	0.68693	0.759466	1.446396
Mining			
5-14-year-olds	1.19904	1.470104	2.669144
15-17-year-olds	1.16760	1.448284	2.615884
Construction			
5-14-year-olds	0.56205	0.825893	1.387943
15-17-year-olds	0.55200	0.813394	1.365394
Manufacturing			
5-14-year-olds	0.14988	0.271402	0.421282
15-17-year-olds	0.14720	0.276644	0.423844
Service			
5-14-year-olds	0.11241	0.151844	0.264254
15-17-year-olds	0.11040	0.158149	0.268549
Retail			
5-14-year-olds	0.11241	0.364978	0.477388
15-17-year-olds	0.11040	0.378888	0.489288

Source: Previous tables.

Table 61. Distribution of child workers among major industry division

Age	5-14		15-17	
Major industry division	N (in millions FTE workers)	%	N (in millions FTE workers)	%
Agriculture	109.7	70.4	17.8	14
Mining	1.4	0.9	1.1	0.9
Construction	3.0	1.9	11.3	8.9
Manufacturing	12.9	8.3	31.3	24.6
Services	16.1	10.3	40.6	31.9
Retail	12.9	8.3	24.8	19.5
Total	156	100.1	127	99.8

Sources: ILO. 2002. *Every child counts: New global estimates on child labou*r. Geneva: International Labour Organization. p 55. ILO. 1998. Statistics on Working Children and Hazardous Child Labour in Brief; and A. Fausto, R. Cervini. 1996. *O Trabalho e a Rua: Crianças e adolescentes no Brasil urbano dos anos 80 São Paulo*, SP: Cortez Editora.

Table 62. DALY due to work-related fatal and non-fatal injuries in the world by major industry division

Major industry division and age group	N (in millions FTE workers)	DALY per 100 FTE workers per year	Total DALYs (in millions) per year
5-14-year-olds			
Agriculture	109.7	1.514878	1.661821
Mining	1.4	2.669144	0.037368
Construction	3.0	1.387943	0.041638
Manufacturing	12.9	0.421282	0.054345
Services	16.1	0.264254	0.042545
Retail	12.9	0.477388	0.061583
Total	156.0	1.217501	1.899301
15-17-year-olds			
Agriculture	17.8	1.446396	0.257458
Mining	1.1	2.615884	0.028775
Construction	11.3	1.365394	0.154290
Manufacturing	31.3	0.423844	0.132663
Services	40.6	0.268549	0.109031
Retail	24.8	0.489288	0.121343
Total	127.0	0.632725	0.803560
5-17-year-olds			
Agriculture	127.5	1.505317	1.919280
Mining	2.5	2.645710	0.066143
Construction	14.3	1.370125	0.195928
Manufacturing	44.2	0.423096	0.187009
Services	56.6	0.267802	0.151576
Retail	37.7	0.485216	0.182926
Total	283.0	0.955075	2.702861

Sources: Tables 52-56 and 61.

Table 63. DALY estimates for unconditional worst forms of child labour

Unconditional worst forms of child labour (world)	N (in millions FTE workers)	DALY per 100 FTE workers per year	Total DALY (in millions) per year
5-17-year-olds			
Trafficked	1.2	2.669144	0.032030
Forced and bonded labour	5.7	2.669144	0.152141
Armed conflict	0.3	2.669144	0.008007
Prostitution and pornography	1.8	2.669144	0.048045
Illicit activities	0.6	2.669144	0.016015
Total	9.6	2.669144	0.256238

Sources: ILO. 2002. Every child counts: New global estimates on child labour, Geneva: International Labour Organization, p, 55; and previous tables..

Table 64. YLL due to AIDS per 100 children in prostitution per year by age (fatality rate times YLL per fatal injury)

Children in prostitution	Age of death	AIDS mortality rate per 100 children in prostitution	YLL per AIDS	YLL per 100 children in prostitution per year	
5-14-year-olds	15	0.2	36.98656	7.397312	per 100 children in prostitution
15-17-year-olds	25	0.2	32.78413	6.556826	per 100 children in prostitution

Sources: H. Ward, S. Day, J. Weber,. 1999. Risky business: health and safety in the sex industry over a nine year period. Sex Transm Infect 75: 340-343. C. Murray, A. Lopez, 1996. The Global Burden of Disease. Boston: Harvard School of Public Health.

Table 65. YLD for each HIV case

Age	Average age of onset	Disability weight	Duration of disability	YLD per HIV case
5-14-year-olds	10	0.123	7.2	1.028167
15-17-year-olds	16	0.136	7.3	1.314371

Source: C. Murray, A. Lopez, 1996. The Global Burden of Disease. Boston: Harvard School of Public Health.

Table 66. YLD due to HIV cases per 100 children in prostitution per year by age (incidence rate times YDL per HIV case)

Children in prostitution	HIV incidence rate per 100 children in prostitution	YLD per HIV case	YLD for HIV cases per 100 children in prostitution	
5-14-year-olds	0.2	1.028167	0.205633	per 100 children in prostitution
15-17-year-olds	0.2	1.314371	0.262874	per 100 children in prostitution

Sources: H. Ward, S. Day, J. Weber,. 1999. Risky business: health and safety in the sex industry over a nine year period. Sex Transm Infect 75: 340-343; and table 65.

Table 67. YLD for each AIDS case

Age	Average age of onset	Disability weight	Duration of disability	YLD per AIDS case
5-14-year-olds	17.2	0.505	1.02	0.733397
15-17-year-olds	23.3	0.505	1.29	0.973377

Source: C. Murray, A. Lopez, 1996. The Global Burden of Disease. Boston: Harvard School of Public Health.

Table 68. YLD due to AIDS cases per 100 children in prostitution per year by age (incidence rate times YDL per AIDS case)

Children in prostitution	AIDS incidence rate per 100 children in prostitution	YLD per AIDS case	YLD for AIDS cases per 100 children in prostitution
5-14-year-olds	0.2	0.733397	0.146679 per 100 children in prostitution
15-17-year-olds	0.2	0.973377	0.194675 per 100 children in prostitution

Sources: H. Ward, S. Day, J. Weber,. 1999. Risky business: health and safety in the sex industry over a nine year period. Sex Transm Infect 75: 340-343; and table 67.

Table 69. DALY due to HIV-AIDS in children in prostitution by age (sum of YLL and YLD)

Children in prostitution	YLL	YLD for HIV	YLD for AIDS	DALY per 100 children in prostitution per year
5-14-year-olds	7.397312	0.205633	0.146679	7.749624
15-17-year-olds	6.556826	0.262874	0.194675	7.014375

Sources: Tables 64, 66, and 68.

Table 70. Standard life expectancies at each age and YLL due to a death at each age

Age (years)	Life expectancy (years)		YLL due to death at each age	
	Females	Males	Females	Males
0	82.50	80.00	33.12	33.01
1	81.84	79.36	34.07	33.95
5	77.95	75.38	36.59	36.46
10	72.99	70.40	37.62	37.47
15	68.02	65.41	36.99	36.80
20	63.08	60.44	35.24	35.02
25	58.17	55.47	32.78	32.53
30	53.27	50.51	29.92	29.62
35	48.38	45.57	26.86	26.50
40	43.53	40.65	23.74	23.32
45	38.72	35.77	20.66	20.17
50	33.99	30.99	17.69	17.12
55	29.37	26.32	14.87	14.21
60	24.83	21.81	12.22	11.48
65	20.44	17.50	9.75	8.95
70	16.20	13.58	7.48	6.69
75	12.28	10.17	5.46	4.77
80	8.90	7.45	3.76	3.27
85	6.22	5.24	2.45	2.12
90	4.25	3.54	1.53	1.30
95	2.89	2.31	0.94	0.76
100	2.00	1.46	0.57	0.42

Source: C. Murray, A. Lopez, 1996. The Global Burden of Disease. Boston: Harvard School of Public Health.

Table 71. Disability severity weights and durations for treated and untreated natures of injury for 5-17-year olds

Nature of injury	Disability weight		Duration	
	Untreated	Treated	Untreated	Treated
Fracture skull: short-term	0.431	0.431	0.107	0.107
Fracture skull: lifelong (15% of incident cases)	0.410	0.350	LL	LL
Fracture face	0.223	0.223	0.118	0.118
Fracture vertebral column	0.266	0.266	0.140	0.140
Injured spinal cord: lifelong	0.725	0.725	LL	LL
Fracture rib or sternum: short-term	0.199	0.199	0.115	0.115
Fracture pelvis: short-term	0.247	0.247	0.126	0.126
Fracture clavicle, scapula, or Humerus: short-term	0.153	0.153	0.112	0.112
Fracture radius or ulna: short-term	0.180	0.180	0.112	0.112
Fracture hand bones	0.100	0.100	0.070	0.070
Fracture femur: short-term	0.372	0.372	0.241	0.139
Fracture femur: lifelong (5% of treated) (50% untreated)	0.272	0.272	LL	LL
Fracture patella, tibia, or fibula: Short-term	0.271	0.271	0.179	0.090
Fracture ankle: short-term	0.196	0.196	0.146	0.096
Fracture bones in foot: short-term	0.077	0.077	0.073	0.073
Other dislocation	0.000	0.000		
Dislocated shoulder, elbow, or hip Short-term	0.074	0.074	0.035	0.035
Sprains	0.064	0.064	0.038	0.038
Intracranial injury: short-term	0.359	0.359	0.067	0.067
Intracranial injury: lifelong (5% of incident cases)	0.410	0.350	LL	LL
Internal injuries: short-term	0.000	0.208	0.000	0.042
Open wound	0.108	0.108	0.052	0.024
Injury to eyes: lifelong	0.354	0.300	LL	LL
Amputated thumb: lifelong	0.165	0.165	LL	LL
Amputated finger: lifelong	0.102	0.102	LL	LL
Amputated arm: lifelong	0.308	0.257	LL	LL
Amputated toe: lifelong	0.102	0.102	LL	LL
Amputated foot: lifelong	0.300	0.300	LL	LL
Amputated leg: lifelong	0.300	0.300	LL	LL
Crushing: short-term	0.218	0.218	0.094	0.094
Burns < 20%: short-term	0.186	0.158	0.124	0.083
Burns < 20%: lifelong (100% incident cases)	0.002	0.001	LL	LL
Burns > 20%: short-term	0.469	0.441	0.360	0.279
Burns > 20%: lifelong (100% incident cases)	0.255	0.255	LL	LL
Injured nerves: lifelong (100% incident cases)	0.078	0.064	LL	LL
Poisoning: short-term 5-14-year-olds	0.611	0.611	0.008	0.008
Poisoning: short-term 5-14-year-olds 15-44-year-olds	0.608	0.608	0.008	0.008

Source: Adapted from C. Murray, A. Lopez, op.cit.

Table 72. Reviewed studies on fatal injuries

Author	Place	Source of data and population
Windao, J. et al. (1999)	US 1992-97	Census of Fatal Occupational Injuries
Castillo, D.N., et al. (1997)	USA, 1990-92	NTOF, 111 deaths 16-17-year-olds
Castillo, D.N., et al. (1994)	USA	NTOF, 670 deaths, 16-17-year-olds
Kisner, S.M. and Fosbroke, D.E. (1994)	US 1980-89, 15 states	NTOF Construction work-related fatalities
National Safety Council (1991) in Wilk VA (1993)	US	
Bell, C.A. (1990)	USA 1980-90	NTOF, 7000 occupational injury deaths all ages
US Department of Labor (1990) in Committee on Environmental Health (1995)	US	Farm fatal work-related injuries
Rivara (1985) in Committee on Environmental Health (1995)	US	Farm fatal work-related injuries, 10-19-year-olds

Source: NTOF– National traumatic occupational fatalities.

Table 73. Fatal injury rates in all industries

Author	Age	Yearly rate
Windao, J. et al. (1999)	All ages	5.0 per 100 000 FTE
	15	5.1 per 100 000 FTE
	16	3.4 per 100 000 FTE
	17	3.7 per 100 000 FTE
Castillo, D.N., et al. (1997)	16-17	3.5 per 100 000 FTE
	16-17 male	5.6 per 100 000 FTE
	16-17 female	1.0 per 100 000 FTE
Castillo, D.N. et al. (1994)	16-17	5.1 per 100 000 FTE
	18 and +	6.1 per 100 000 FTE
Bell, C.A. et al. (1990)	16-19	7 per 100 000 workers
	All ages	7.8 per 100 000 workers

Table 74. Fatal injury rates by major industry division

Author	Industry	Age	Yearly rate
Kisner, S.M. and Fosbroke, D.E. (1994)	agriculture	All ages	18.0 per 100 000 FTE
National Safety Council (1991) in Wilk VA (1993)	agriculture	>16	42.0 per 100 000 workers
US Department of Labor (1990) in Committee on Environmental Health (1995)	agriculture	All ages	61.0 per 100 000 workers
Rivara (1985) in Committee on Environmental Health (1995)	agriculture	10-14	13.7 per 100 000 workers
	agriculture	15-19	16.8 per 100 000 workers
Bell, C.A. et al. (1990)	agriculture	All ages	20.7 per 100 000 workers
Kisner, S.M. and Fosbroke, D.E. (1994)	mining	All ages	32.0 per 100 000 FTE
National Safety Council (1991) in Wilk VA (1993)	mining	>16	43.0 per 100 000 workers
Bell, C.A. et al. (1990)	mining	All ages	31.9 per 100 000 workers
Kisner, S.M. and Fosbroke, D.E. (1994)	construction	16-19	15.0 per 100 000 FTE
		All ages	25.6 per 100 000 FTE

Author	Industry	Age	Yearly rate
Bell, C.A. et al. (1990)	construction	All ages	24.0 per 100 000 workers
Kisner, S.M. and Fosbroke, D.E. (1994)	manufacturing	All ages	4.0 per 100 000 FTE
Bell, C.A. et al. (1990)	manufacturing	All ages	5.0 per 100 000 workers
Kisner, S.M. and Fosbroke, D.E. (1994)	services	All ages	3.0 per 100 000 FTE
Bell, C.A.,et al. (1990)	services	All ages	4.0 per 100 000 workers
Kisner, S.M. and Fosbroke, D.E. (1994)	retail	All ages	3.0 per 100 000 FTE
Bell, C.A. et al. (1990)	retail	All ages	3.0 per 100 000 workers

Table 75. Reviewed studies on non-fatal injuries

Author	Place	Source of data and population
Miller, M.E. et al. (1998)	Washington 1988-91	17 800 WCC, 11-17-year-olds, no disability requirements
Brooks and Davis (1996)	Massachusetts 1987-90	2 551 WCC, 14-17-year-olds, 5 or more lost work days, amputation, scarring or permanent loss of function
Kisner, S.M. and Fosbroke, D.E. (1994)	US 1981-86, 15 states	WCC, Supplementary Date System Construction non-fatal injuries
Parker, D.L., et al. (1994a)	Minnesota, 1990-91	534 WCC, DLI, younger than 18 years old, disabled from work for 3 or more days or permanent impairment
Belville, R. et al. (1993)	New York 1980 – 1987	9,656 WCC, 14-17-year-olds, disabled from work for 8 or more days or permanent impairment
Banco, L. et al. (1992)	Connecticut 1989	796 WCC, 14-17-year-olds
Parker, D.L. et al. (1991)	Minnesota 1986-87	1 607 WCC, DLI, 12-17-year-olds, disabled from work for 3 or more days or permanent impairment
Schober, S. et al. (1988)	USA, 24 states	23 823 WCC, younger than 18 years old, rates by industry calculated among 9 states requiring no disability days
NIOSH (1998)	US 1995-97	NEISS, 15 years old
Dufortt, V.M. et al. (1997)	Dunedin, New Zeland 1990-93	ER, 1 361 work-related injuries, 15 years old
CDC (1996) in Castillo, D.N. et al. (1999)	USA, 1996	ER, 16-17-year-olds
Layne, L.A. et al. (1994)	USA July- December 1992	NEISS, 679 occupational injuries, 14-17-year-olds
Brooks, D.R. et al. (1993)	Massachusetts 1979-82	ER and hospitals admissions, 1 176 work-related injuries, 14-17-year-olds
Coleman and Sanderson (1983) in Schober, S. et al. (1988)	USA	NEISS, 16-17-year-olds
White, L. and O'Donnell, C. (2001)	North Tyneside and Norfolk, UK 1996-98	Cross-sectional survey, 10-16-year-olds, 2 725 subjects, 945 workers, 443 accidents
Windao, J. et al. (1999)	US 1996 younger than 18 years old	Survey of occupational injuries and illnesses, non-agricultural work, injuries and illnesses that resulted in lost workdays
Dunn, K.A. et al. (1998)	North Caroline 1990	Population based – telephone survey, 700 teen workers, 14-17-year-olds
ILO (1998)	26 developing countries	Surveys, 5-14-year-olds, includes injuries and illnesses
Parker, D.L. et al. (1994b)	Minnesota 1990-91	Cross-sectional survey, 3 051 high school students, 72% were working and 379 reported work-related injuries in the study period
Glor, E.D. (1989)	Saskatchewan, Canada 1982	Cross-sectional survey, 746 high school students, 105 work-related injuries
Jacobson, B. and Schelp, L. (1988)	Sweden rural municipality 1981-82	Population-based, 49 occupational accidents, 15 years old,

ER – emergency department rooms; WCC – worker's compensation claims; NEISS – National Electronic Injury Surveillance System; NTOFSS – National Traumatic Occupational Fatalities Surveillance System; DLI – Minnesota Department of Labour and Industry.

Table 76. Non-fatal injury rates in all industries

Author	Age	Male rate	Female rate	Yearly rate
Work compensation claims				
Miller, M.E. et al. (1998)	16-17	11.7	6.4	9.0 per 100 workers
	18 or +			10.4 per 100 workers
	16-17	23.3	14.1	18.9 per 100 FTE
	18 or +	12.7	6.3	10.7 per 100 FTE
Brooks and Davis (1996)	16-17	1.9	2.6	1.3 per 100 FTE
Belville, R. et al. (1993)	14-17	0.15	0.41	0.28 per 100 workers
	14	0.11	0.04	0.08 per 100 workers
	15			0.08 per 100 workers
	16			0.27 per 100 workers
	17	0.70	0.24	0.47 per 100 workers
	16			1.1 per 100 FTE
	17			1.9 per 100 FTE
Banco, L. et al. (1992)	16-17			1.5 per 100 workers
Parker et al. (1991)	12-14			0.2 per 100 FTE
	15-17			1.68 per 100 FTE
	adult			2.45 per 100 FTE
Schober, S. et al. (1988)	16-17	12.6	6.6	– per 100 FTE
Emergency departments				
Dufortt, V.M. et al. (1997)	15-19	20.6	5.8	13.7 per 100 FTE
	15			12.4 per 100 FTE
	16			16.9 per 100 FTE
	17			15.0 per 100 FTE
	18			13.1 per 100 FTE
	19			13.2 per 100 FTE
CDC (1996) in Castillo, D.N. et al. (1999)	16-17	6.0	3.9	– per 100 FTE
	all ages	3.3	2.1	– per 100 FTE
Layne, L.A. et al. (1994)	15-17	7.0	4.4	5.8 per 100 FTE
	15	6.7	2.6	4.7 per 100 FTE
	16	6.1	4.7	5.5 per 100 FTE
	17	7.6	4.7	6.3 per 100 FTE
Brooks, D.R. et al. (1993)	16-17	21.9	8.9	16.0 per 100 FTE
Coleman and Sanderson (1983) in Schober, S. et al. (1988)	16-17	8.2	3.0	– per 100 FTE

Author	Age	Male rate	Female rate	Yearly rate
Surveys				
White, L. and O'Donnell, C. (2001) North Tyneside	10-16			44 per 100 workers
	10			54 per 100 workers
	11			26 per 100 workers
	12			52 per 100 workers
	13			49 per 100 workers
	14			45 per 100 workers
	15			41 per 100 workers
	16			50 per 100 workers
White, L. and O'Donnell, C. (2001) Norfolk	10-16			48 per 100 workers
	10			28 per 100 workers
	11			40 per 100 workers
	12			40 per 100 workers
	13			54 per 100 workers
	14			50 per 100 workers
	15			56 per 100 workers
	16			46 per 100 workers
Parker, D.L. et al. (1994b)	teens	47	40	43 per 100 000 person-hours
(reportable injuries)	teens	17	13	15 per 100 000 person-hours
Glor, E.D. (1989)	teens			18 per 100 workers
Jacobson, B. and Schelp, L. (1988)	15-19	9.36	2.47	6.43 per 100 workers
	20 or +	4.69	1.13	3.22 per 100 workers

Table 77. Non-fatal injury rates in agriculture

Author	Age	Yearly rate
Work compensation claims		
Miller, M.E. et al. (1998)	16-17	11.4 per 100 workers
	16-17 male	12.3 per 100 workers
	16-17 female	8.6 per 100 workers
	18 or +	12.8 per 100 workers
Brooks and Davis (1996)	16-17	1.2 per 100 FTE
Belville, R. et al. (1993)	14-17	0.46 per 100 workers
	14	0.12 per 100 workers
	15	0.25 per 100 workers
	16	0.67 per 100 workers
	17	0.72 per 100 workers
Banco, L. et al. (1992)	16-17	0.18 per 100 workers
Schober, S. et al. (1988)	16-17 male	8.4 per 100 FTE
	16-17 female	7.2 per 100 FTE

Author	Age	Yearly rate
Emergency departments		
NIOSH (1998)	15-17	1.8 per 100 FTE
	15-19	2.3 per 100 FTE
	15-19 male	2.4 per 100 FTE
	15-19 female	1.5 per 100 FTE
	All ages	1.6 per 100 FTE
Layne, L.A. et al. (1994)	15-17	4.3 per 100 FTE
Surveys		
ILO (1998)	5-14	12.2 per 100 workers
	5-14 male	12.1 per 100 workers
	5-14 female	15.5 per 100 workers
Glor, E.D. (1989)	Teens	20 per 100 workers
Jacobson, B. and Schelp, L. (1988)	15-19	9.68 per 100 workers
	20 or +	6.72 per 100 workers

Table 78. Non-fatal injury rates in mining

Author	Age	Rate	Yearly rate
Work compensation claims			
Schober, S. et al. (1988)	16-17male	8.2	per 100 FTE
	16-17 female	5.5	per 100 FTE
Surveys			
ILO (1998)	5-14	15.9	per 100 workers
	5-14 male	12.1	per 100 workers
	5-14 female	20.8	per 100 workers

Table 79. Non-fatal injury rates in construction

Author	Age	Rate	Yearly rate
Work compensation claims			
Miller, M.E. et al. (1998)	16-17	21.1	per 100 workers
	18 or +	24.6	per 100 workers
Brooks and Davis (1996)	16-17	3.2	per 100 FTE
Kisner, S.M. and Fosbroke, D.E. (1994)	16-19	8	per 100 FTE
Belville, R. et al. (1993)	15-17	0.33	per 100 workers
	15	0.10	per 100 workers
	16	0.21	per 100 workers
	17	0.63	per 100 workers
Banco, L. et al. (1992)	16-17	0.51	per 100 workers
Schober, S. et al. (1988)	16-17 male	7.2	per 100 FTE
	16-17 female	3.3	per 100 FTE

Author	Age	Rate	Yearly rate
Emergency departments			
Dufortt, V.M. et al. (1997)	15-19	25.7	per 100 FTE
Layne, L.A. et al. (1994)	15-17	4.8	per 100 FTE
Surveys			
ILO (1998)	5-14	25.6	per 100 workers
	5-14 male	25.8	per 100 workers
	5-14 female	34.8	per 100 workers
Glor, E.D. (1989)	teens	27	per 100 workers
	All ages	10	per 100 FTE

Table 80. Non-fatal injury rates in manufacturing

Author	Age	Yearly rate	
Work compensation claims			
Miller, M.E. et al. (1998)	16-17	8.6	per 100 workers
	16-17 male	10.9	per 100 workers
	16-17 female	4.0	per 100 workers
	18 or +	14.0	per 100 workers
Brooks and Davis (1996)	16-17	3.0	per 100 FTE
Belville, R. et al. (1993)	14-17	0.49	per 100 workers
	14	0.44	per 100 workers
	15	0.47	per 100 workers
	16	0.51	per 100 workers
	17	0.51	per 100 workers
Banco, L. et al. (1992)	16-17	0.54	per 100 workers
Schober, S. et al. (1988)	16-17 male	9.6	per 100 FTE
	16-17 female	5.1	per 100 FTE
Emergency departments			
Dufortt, V.M. et al. (1997)	15-19	14.8	per 100 FTE
Layne, L.A. et al. (1994)	15-17	5.1	per 100 FTE
Surveys			
ILO (1998)	5-14	9.3	per 100 workers
	5-14 male	11.0	per 100 workers
	5-14 female	8.5	per 100 workers
Jacobson, B. and Schelp, L. (1988)	15-19	7.16	per 100 workers
	20 or +	5.18	per 100 workers

Table 81. Non-fatal injury rates in services

Author	Age	Yearly rate
Work compensation claims		
Miller, M.E. et al. (1998)	16-17	5.5 per 100 workers
	16-17 male	8.2 per 100 workers
	16-17 female	3.8 per 100 workers
	18 or +	5.7 per 100 workers
Brooks and Davis (1996)	16-17	1.6 per 100 FTE
Belville, R. et al. (1993)	14-17	0.16 per 100 workers
	14	0.02 per 100 workers
	15	0.06 per 100 workers
	16	0.19 per 100 workers
	17	0.28 per 100 workers
Banco, L. et al. (1992)	16-17	1.24 per 100 workers
Schober, S. et al. (1988)	16-17 male	14.6 per 100 FTE
	16-17 female	5.7 per 100 FTE
Emergency departments		
Dufortt, V.M. et al. (1997)	15-19	13.1 per 100 FTE
Layne, L.A. et al. (1994)	15-17	4.1 per 100 FTE
Surveys		
ILO (1998)	5-14	7.8 per 100 workers
	5-14 male	9.3 per 100 workers
	5-14 female	8.5 per 100 workers
Jacobson, B. and Schelp, L. (1988)	15-19	20.5 per 100 workers
	20 or +	1.77 per 100 workers

Table 82. Non-fatal injury rates in retail/trade

Author	Age	Yearly rate
Work compensation claims		
Miller, M.E. et al. (1998)	16-17	9.7 per 100 workers
	16-17 male	12.4 per 100 workers
	16-17 female	7.4 per 100 workers
	18 or +	12.0 per 100 workers
Brooks and Davis (1996)	16-17	1.9 per 100 FTE
Belville, R. et al. (1993)	14-17	0.33 per 100 workers
	14	0.03 per 100 workers
	15	0.04 per 100 workers
	16	0.30 per 100 workers
	17	0.57 per 100 workers
Banco, L. et al. (1992)	16-17	2.04 per 100 workers
Schober, S. et al. (1988)	16-17 male	14.6 per 100 FTE
	16-17 female	7.8 per 100 FTE

Author	Age	Yearly rate
Emergency departments		
Dufortt, V.M. et al. (1997)	15-19	9.0 per 100 FTE
Layne, L.A. et al. (1994)	15-17	6.3 per 100 FTE
Surveys		
ILO (1998)	5-14	8.3 per 100 workers
	5-14 male	8.6 per 100 workers
	5-14 female	9.8 per 100 workers

Table 83. Prevalence of injury by nature in all industries

Author	Age (years old)	Cut, laceration, puncture	Contusion, Concussion, bruise	Sprain, strain	Burn	Fracture	Amputation	Eye injury
Work compensation claims								
Miller, M.E. et al. (1998)	11–17	34.0	13.0	17.7	9.0	2.8	0.2	1.2
Parker, D.L., et al. (1994a)	≤ 18	24.0	12.0	38.0	13.0	9.0	–	–
Banco, L. et al. (1992)	16–17	35.0	25.0	22.0	7.0	–	–	–
Parker, D.L. et al. (1991)	12–17	26.5	8.8	27.1	13.1	5.7	0.4	–
	All ages	10.6	6.7	44.6	2.6	6.0	0.2	–
Schober, S. et al. (1988)	≤ 18 total	36.5	12.8	17.3	9.7	5.8	0.6	–
	≤ 15 male	41.0	12.6	12.0	4.8	9.2	0.7	–
	≤ 15 female	29.8	14.5	19.9	9.0	6.0	0.3	–
	16–17 male	39.4	12.0	15.4	8.9	6.4	0.8	–
	16–17 female	28.9	14.8	23.4	13.2	3.3	0.2	–
Emergency departments								
Dufortt, V.M. et al. (1997)	15–19	29.4	9.9	15.9	5.8	–	–	–
Layne, L.A. et al. (1994)	14–17	34.5	18.2	16.2	12.4	4.2	–	–
Brooks, D.R. et al. (1993)	14–17 total	49.1	12.2	9.6	6.4	3.0	0.4	7.5
	14–17 male	51.2	10.9	8.2	5.3	4.0	0.6	9.0
	14–17 female	42.5	16.3	13.9	9.5	0	0	3.1
	14	80.0	0	0	6.7	0	0	11.1
	15	60.6	6.1	6.1	6.1	12.1	0	3.0
	16	58.0	8.0	5.7	5.1	0	0	6.8
	17	41.7	15.7	12.5	7.0	3.8	0.7	8.0
Surveys								
White, L. and O'Donnell, C. (2001) North Tyneside	10–16	34.3	10.8	10.8	0	7.8	–	–
White, L. and O'Donnell, C. (2001) Norfolk	10–16	47.1	11.3	4.8	4.1	3.4	–	–
Windao, J. et al. (1999)	Under 18	13.0	14.0	33.0	9.0*	12.0		

Author	Age (years old)	Cut, laceration, puncture	Contusion, Concussion, bruise	Sprain, strain	Burn	Fracture	Amputation	Eye injury
Dunn, K.A. et al. (1998)	14–17	29.0	–	–	24.0	–	–	–
ILO (1998)	5–14	69.0	16.0		7.0		1.0	
Jacobson, B. and Schelp, L. (1988)	15–19	35.0	27.0	–	–	–	–	18.0

Table 84. Prevalence of injury by nature by major industry division

Author	Age	Cut, laceration, puncture	Contusion, concussion, bruise	Sprain, strain	Burn	Fracture
Agriculture						
Brooks and Davis (1996)	14–17	26.7	–	23.3		–
NIOSH (1998)	< 20	23.3	24.0	–	–	–
Layne, L.A. et al. (1994)	14–17	35.6	14.9	7.9	0.7	14.4
Manufacturing						
Brooks and Davis (1996)	14–17	18.2	19.6	33.2		10.7
Dufortt, V.M. et al. (1997)	15–19	33.2	8.8	13.0	3.9	–
Layne, L.A. et al. (1994)	14–17	20.8	10.0	32.3	7.5	2.9
Construction						
Brooks and Davis (1996)	14–17	27.4	14.5	18.8	–	15.4
Kisner, S.M. and Fosbroke, D.E. (1994)	All ages	24.4	9.0	34.3	–	10.8
Dufortt, V.M. et al. (1997)	15–19	31.1	11.2	8.7	2.6	–
Retail						
Brooks and Davis (1996)	14–17	29.0	17.3	29.2	5.9	7.6
Dufortt, V.M. et al. (1997)	15–19	37.0	7.1	21.9	8.4	–
Layne, L.A. et al. (1994)	14–17	39.0	13.5	15.9	17.7	3.8
Services						
Brooks and Davis (1996)	14–17	13.4	13.4	46.3	5.4	7.2
Layne, L.A. et al. (1994)	14–17	23.1	30.0	16.4	9.1	2.8

Table 85. Main body parts injured by nature of injury or by major industry division, non-fatal injuries

Bibliographical reference and injury
Parker DL, et al. (1994a) Sprain and strain - 73% low and mid back Lacerations cuts and abrasions – most frequently affected hand and fingers Bruises and contusions – 25% hand and fingers, 16% knee and arm, 15% back Fractures – 43% finger, 19% foot and toe
Miller, M.E. et al. (1998) Laceration – 83% upper extremity, 11% lower extremity Sprain – 46% back/neck, 27% upper extremity, 23% lower extremity Contusion – 44% upper extremity, 34% lower extremity Burn/heat – 70% upper extremity, 16% lower extremity Burn/chemical – 65% eye, 17% upper extremity Abrasion – 82% eye Fracture - 60% upper extremity, 28% lower extremity Amputation – 100% upper extremity Dislocation – 62% lower extremity, 29% upper extremity
Brooks and Davis (1996) 14-17 years-old Amputation – 82% finger Sprains/strains – 45% back Lacerations – 80% hand or finger Fractures – 16.1% finger, 13.3% hand, 13.3% wrist, 11.5% foot Heat burns – 40% hand or finger
Parker, D.L. et al. (1991) 12-17 years-old Laceration – 10.6% finger Amputation - 85.7% finger, 14.3% multiple upper extremity parts
Layne, L.A. et al. (1994) Laceration – 74.1% hand or finger; 9.2% leg, knee or ankle; 8.6%head, face or neck; 6.6% wrist or arm; 0.4% trunk or shoulder; 1% foot or toe Contusion or abrasion – 32.7% hand or finger; 13.6% leg, knee or ankle; 13.8%head, face or neck; 14.1% wrist or arm; 16.1% trunk or shoulder; 8.6% foot or toe; 1.0% all other Sprain or strain – 15.9% hand or finger; 27.1% leg, knee or ankle; 0.6%head, face or neck; 19.8% wrist or arm; 34.3% trunk or shoulder; 2.3% foot or toe Burn – 35% hand or finger; 9.1% leg, knee or ankle; 23.6%head, face or neck; 18.2% wrist or arm; 5.8% trunk or shoulder; 7.1% foot or toe; 1.3% all other Fracture or dislocation – 39.5% hand or finger; 22.9% leg, knee or ankle; 22.0% wrist or arm; 4.6% trunk or shoulder; 10.7% foot or toe All other – 29.1% hand or finger; 7.7% leg, knee or ankle; 26.8%head, face or neck; 4.6%wrist or arm; 3.4% trunk or shoulder; 15.0% foot or toe; 13.4% all other Total – 44.3% hand or finger; 13.2% leg, knee or ankle; 12.4%head, face or neck; 11.9%wrist or arm; 10.0% trunk or shoulder; 5.8% foot or toe; 2.3% all other Manufacturing - lacerations – 47% hand or finger, 24.8% leg, knee or ankle Retail trade- all injuries - 50% hand or finger
Dufortt, V.M. et al. (1997) Laceration – 90% upper extremity (3.5% wrist, 80.5% hand); 5.5% head/neck (0.5% eye); 4.3% lower extremity (1.0% foot) Contusion – 55.6% upper extremity (8.9% wrist, 34.8% hand); 8.9% head/neck (0.3% eye); 7.8% lower extremity (3.8% foot) Burn, partial thickness – 38.0% upper extremity (2.5% wrist, 27.8% hand); 18.5% head/neck (34.2% eye); 16.5% lower extremity (12.7% foot) Sprain/strain – 40.3% upper extremity (12.0% wrist, 16.7% hand); 5.6% head/neck; 31.0% lower extremity (7.4% foot) Total – 55.9% upper extremity (42.7 hand); 23.4% head (18.0% eye); 15.2% lower extremity (6.0% foot) Construction – 50.5% upper extremity (39.8% hand); 29.1% head (25.5% eye); 13.3% lower extremity (5.6% foot) Manufacturing – 58.3% upper extremity (46.1% hand); 26.8% head (23.2% eye); 8.8% lower extremity (3.0% foot) Retail trade – 61.8% upper extremity (46.2% hand); 10.9% head (5.9% eye); 15.1% lower extremity (7.6% foot)
Kisner, S.M. and Fosbroke, D.E. (1994) construction Sprain/strain – 48.4% back, 1.2% finger, 10.8% leg, 39.7% other Cut, laceration, puncture, scratch – 0.4% back, 6.6% finger, 7.4% leg, 30.3 eye, 36.1% other Fracture – 3.7% back, 16.7% finger, 7.4% leg, 72.2% other Contusion/bruise 5.6% back, 12.2% finger, 18.9% leg,1.1% eye, 62.2% other Other – 9.8% back, 7.0% finger, 7.9% leg, 7.4 eye, 67.9% other
NIOSH (1998) Agriculture – 23.5% hands; 23.0% knee, ankle, or foot

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