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A global estimate of work-related injuries among children

International Programme on the Elimination of Child Labour (IPEC)

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Preface

June 2011, the World Day Against Child Labour was dedicated to the issue of hazardous child labour, launching a year of action and research devoted to this topic. Although there were already good estimates of the total numbers of children in various kinds of labour, there were no global statistics on the health impacts of this premature work. Therefore, ILO-IPEC decided to investigate whether there might be sufficient data in its archives of child labour surveys, of which there were over fifty at the time, to prepare at least a rough estimate for the purposes of advocacy in connection with World Day.

Due to the fact that we were dealing with new, previously unanalyzed data, a new issue, and a new method of estimation, this paper has had to go through numerous iterations. Each round, however, has contributed to a greater appreciation of the subject and better understanding of how it should be approached. It is clear that, even with the datasets currently available a great deal more analysis could be done. This paper reflects only the tip of the iceberg.

This study is the first to produce a global estimate of the number of children who have been injured at work. It calculates that in a one year period, 106.4 million children, age 5-17, experience a work-related injury. Of these, 15.1 million children suffer a work-related injury sufficiently severe that it meets the impact threshold of requiring medical attention and resulting in at least one day lost from work or school. The incidence rate for injuries above the severity threshold is 4.1%.

The methodology for the study involved an extrapolation for the year 2008, based on data from child labour household surveys that were conducted in 21 developing countries between the years 2001 and 2009. Injuries were defined by the extent to which they met the impact threshold, and children were classified by sex, age and labor force status.

1. Introduction

In 2008 there were an estimated 215 million child laborers globally, of whom more than half—115 million—were engaged in what has been deemed hazardous work. (Diallo et al., 2010) The definition of hazardous work adopted by the 18th Conference of Labor Statisticians in 2008 (ILO, 2009) and codified in ILO Recommendation No. 190 identifies the following criteria:

- Work which exposes children to physical, psychological or sexual abuse.
- Work underground, under water, at dangerous heights or in confined spaces.
- Work with dangerous machinery, equipment and tools, or which involves the manual handling or transport of heavy loads.
- Work in an unhealthy environment which may, for example, expose children to hazardous substances, agents or processes, or to temperatures, noise levels, or vibrations damaging their health.
- Work under particularly difficult conditions such as work for long hours or during the night or work where the child is unreasonable confined to the premises of the employer.

In practice, for the purpose of global estimation, the ILO measures hazardous work by children as all children (5 to 17 years old) engaged in designated hazardous industries and occupations or those who worked long hours during the reference week (43 or more hours) or in some hazardous working conditions not captured by the previous two criteria. (ILO, 2010) This procedure is therefore based on perceived risk exposures of children, but not, as yet, on actual outcomes, such as the relative incidence rates of work-related injuries and illnesses.

The purpose of this paper is to begin the process of constructing outcome-based measures of hazardous child labor. It begins with a review of global estimates for adult work-related forms of morbidity and mortality, with an eye toward the potential contribution that child labor estimates can make due to their more extensive data resources. It then describes the methodology of the current study, reports its results and concludes with suggestions for further research.

2. Global estimates of work-related morbidity and mortality

The past decade has witnessed a number of studies that construct estimates for the global burden of work-related injuries and illnesses (Fingerhut et al., 2005) and specific components such as general injuries (Concha-Barrientos et al., 2005; Hämäläinen et al., 2006), fatal diseases (Hämäläinen et al., 2007; Hämäläinen et al., 2011), and particular injury and disease categories (Driscoll et al., 2005a; Driscoll et al., 2005b; Punnett et al., 2005; Nelson et al., 2005). The results in the Hämäläinen et al. studies are reported as event counts; the remaining studies employ the Disability Adjusted Life Year (DALY) metric, building on the conceptual and empirical work embodied in the World Health Organization's (WHO) Global Burden of Disease reports. (Murray and Lopez, 1996; Lopez et al., 2006; World Health Organization, 2008)

Although this body of research has been meticulous and has shed valuable light on the global extent and severity of work-related disorders, they are likely to underestimate the true extent of disability in that there are limited data for (a) the informal economy, (b) developing countries, and (c) child workers. While epidemiological data on occupational morbidity and mortality are abundant in developed countries, they are difficult to obtain for the developing world, which encompasses the majority of all workers and, in all likelihood, the most hazardous working conditions. Moreover, injury data from the US and the European Union show young workers as having a higher rate of occupational injury than adult workers.

Global burden estimates typically perform two levels of extrapolation. First, they extrapolate incomplete evidence from specific countries for which data are available to population estimates for those countries, and then they extrapolate these population estimates to countries for which little or no data are available. There is probable measurement error in both steps.

Extrapolation to the national level is more prone to error to the extent that gaps in data coverage are nonrandom. This can occur either because of selection bias in the sample itself or the nonrandom selection of diseases or impairments used as the basis for estimating the full spectrum of morbidity and mortality events. An example of the first would be the use of administrative records from insurance systems that cover only the better-regulated workplaces (the formal sector) in an economy with a substantial informal or self-employed sector. An example of the second would be the extrapolation of attributable fractions (the proportion of diseases attributable to occupational etiology) derived from better monitored diseases or work situations to others that are poorly monitored. Such error is unavoidable, of course.

Extrapolation from one set of countries to another is more prone to error when their characteristics differ in ways germane to the probable incidence of work-related disorders. Attempts can be made to control for some of these, such as the distribution of the labor

force according to major industries and occupations, but others—particularly those associated with different levels of development, labor market institutions and regulatory capacity—are more difficult to incorporate.

The existing global burden literature reflects both of these issues. (1) Most studies rely primarily on empirical regularities, such as attributable fractions that are derived from developed country data and extrapolated to developing countries. Examples include Hämäläinen et al. (2011), where attributable fractions are extrapolated from Finnish data, and Nelson et al. (2005) which is based on US data. (2) Studies that utilize data from selected developing countries to extrapolate to others (typically within the same WHO region) rely primarily on workers' compensation insurance records. These records are the most reliable source for most such countries but since it is primarily formal sector workers who are insured, researchers regard extrapolations to the entire national population to provide lower bounds only.

It is in this context that global estimates of child labor injuries can make a contribution. Because the prevalence of child labor is largely concentrated in developing countries, we have a relatively abundant set of data resources to utilize. Moreover, since child labor occurs almost entirely within the informal sector, data are normally gathered through household rather than employer surveys, thus better representing the general population. There is reason to expect that global estimates for this population will be much more precise. The current study draws on the body of household surveys supported by the ILO's Statistical Information and Monitoring Programme on Child Labour (SIMPOC), which has promoted a standardized methodology in child labor data collection. (SIMPOC, 2004)

Unfortunately, because household surveys typically have modest sample sizes, it is not possible to obtain enough observations on particular injury outcomes to construct DALY measurements with enough precision to support extrapolation. Moreover, household surveys may not be valid instruments for obtaining the sort of impairment information DALY methodology requires. Thus the output of the current study is the simple incidence of injuries among child laborers, rendering it not directly comparable to DALY estimates cited above. Nevertheless, we will be able to compare it to the incidence rates estimated in Hämäläinen et al. (2006).

3. Methodology

3.1 Definitions

Qualifying work-related injury. Respondents to a household survey may interpret a general question about injuries rather loosely; without additional information we cannot be certain that a reported work-related injury would qualify as reportable under an insurance system, were one in place. Thus we will distinguish between any reported work-related injury and those for which sufficient information is available and which indicate that the injury has attained a threshold of severity. For the purposes of this study, a qualifying work-related injury is defined as any a) superficial injury, b) fracture, c) dislocation, sprain or stain, d) burn, corrosion, scald or frostbite, or e) other corporal lesion that resulted from a work-related accident and led to the child being forced to stop working or going to school for more than one day. Impact is said to be severe if the injury led to hospitalization. The impact is mild if the injury was not severe, but the child had some medical treatment An injury which had no impact on the child's health or life in either sense described above is not counted as a qualifying work-related injury. In this document, we report both qualifying work-related injuries and all reported work-related injuries.

Child laborer. Our definition is based on ILO Convention 138. Children are persons below 18 years of age. They are considered child labor if the work they are engaged in (which can include nonmarket work whose product lies within the System of National Accounts) constitutes a risk to their health or education and is conflicts with the minimum age guidelines of this Convention. Thus, not all economic activity by children is regarded as child labor; for instance, in the most recent report cited above, an estimated 306 million children were economically active, while just 70% of this number were deemed child laborers.

Injury incidence rate. Here our numerators will be the number of children experiencing work-related injuries during a reference year (both qualifying and total), and our denominator the number of all working children during the same reference year. This embodies choices. First, we choose the number of children experiencing injuries rather than the number of injuries. In fact, this does not alter our results substantially: the ratio of injuries to injured children is 1.16, with little variation across countries or categories of children. Second, we choose a year as the reference period. This is a practical consideration based on the questions asked in the child labor surveys we used, but it also reflects the need to accumulate as large a sample of injuries as possible. Using a reference year in the numerator requires harmonization in the denominator, especially as frequent movement in and out of child labor greatly increases the number of identified children in a longer reference period. (Levison et al., 2007) At the same time, however, the longer reference period increases the potential for recall error. In this context, on the other hand, there is no prior basis for presuming a recall bias in either direction.

3.2 Extrapolation variables

These are derived from our classifications of children and their economic activities. Children were classified by sex and age group; the age groups, which correspond to Convention No. 138 criteria, were 5-11, 12-14 and 15-17. Branches of economic activity were classified as follows:

- Agriculture
- Industry
  - Mining and quarrying
  - Construction
  - Other industries
- Services
  - Domestic services
  - Other services

3.3 Criteria for national data sets

Selection of data sets for inclusion were based on the following criteria, all of which had to be satisfied. (Table 1 lists the countries and years for which satisfactory data were identified.)

- Was the survey implemented between 2000 and 2009?
- Were the survey results validated by the ILO?
- Are the necessary extrapolation variables present in the survey?
- Are the questionnaires available and interpretable?
- Does the questionnaire ask for specific information on the nature of the physical impairment?
- Is the reference period explicit in the questionnaire?
- Is there a question specifically addressing the work-relatedness of the injury?
- Is there a question specifically addressing the extent of the injury's impact on the child or his/her activity?

Table 1. National child labor surveys meeting selection criteria

Benin	2008	Honduras	2002	Panama	2008
Burkina Faso	2008	Indonesia	2009	Peru	2007
Cambodia	2001	Jordan	2007	Philippines	2001
Colombia	2001	Kyrgyzstan	2007	Rwanda	2008
Ecuador	2006	Madagascar	2007	Senegal	2005
El Salvador	2001	Moldova	2010	Tanzania	2006
Ghana	2000	Niger	2008	Turkey	1999

3.4 Imputation of missing variables

Classification of injury events according to impact was derived from more detailed data about the nature of children's impairments. In some countries the questionnaire asked about some of the potential qualifying impacts but not all of them. Thus there were missing observations which could potentially be imputed. It was decided not to impute them as part of this exercise; hence injuries for which incomplete information existed were categorized as non-qualifying.

3.5 Extrapolation to countries without survey data

For many of its global reports, the ILO treats missing country-level data as nonresponse and estimates response probabilities from a range of other national-level variables. In this situation, however, there are not enough responses to reliably estimate such probabilities; hence the countries with data were treated as a random sample of the entire population of countries, stratified by regions. (The four regions employed were Asia and Pacific, Sub-Saharan Africa, Latin America and Caribbean, and Other.) Extrapolation weights were constructed separately for sex and age classifications and were based on child population ratios for 2008, incorporating adjustments for sample population weights. Table 2 presents the number of sample countries and their share of total child population by region.

Table 2. Sample Coverage of Children Ages 5-17 by Region, in Millions and Percent

	Children ages 5-17			
	Sample countries	Sample countries	Total	Coverage rate
World	21	176.9	1,586.3	11.2
Asia and the Pacific	3	88.0	853.9	10.3
Sub-Saharan Africa	8	41.1	257.1	16.0
Latin America & Caribbean	6	27.8	141.0	19.7
Other regions	4	19.9	334.3	6.0

4. Results

Table 3 summarizes the main results. Injuries are differentiated based on whether they satisfied the impact criteria described above ("qualifying") or were simply reported as work-related by the respondents ("all", which includes "qualifying"). The incidence rate is calculated using the economically active population as a denominator, since all such children, and not only child laborers, appear in the numerator. (The exception is the pair of entries for children specifically in or not in child labor—columns 7 and 8.) Variation can be seen in the incidence rate by sex, age and work status, but the differences are not particularly great. The risk-age gradient is not monotonic, which is not surprising since both developmental and work assignment factors play a role in injury outcomes.

Table 3. Injury and Demographic Data for Working Children, 2008 (in Millions or Percent)

	Sex		Age			Status(*)		
	Boys	Girls	5-11	12-14	15-17	CL	Non-CL	Total
Population	819.9	766.4	852.5	364.4	369.4			1586.3
Economically active	205.6	161.9	115.1	107.6	144.8	274.3	93.2	367.5
Qualifying injuries	9.1	6.0	4.9	4.1	6.1	11.7	3.4	15.1
All work-related injuries	61.6	44.8	30.9	30.8	44.7	77.4	29.0	106.4
Incidence rate (qualifying)	4.4	3.7	4.2	3.8	4.2	4.3%	3.7%	4.1
Incidence rate (all)	30.0	27.7	26.8	28.6	30.1	28.2	31.2	29.0

(*) data have been adjusted by iterative proportional fitting so that the cell totals match the margins.

Using unweighted variation in incidence rates across countries as our measure of sample variance, the standard deviation of the global estimate of qualifying work-related injuries is 2.5 million, or 16.7% of its point estimate. It should be noted that the totals for economically active children and child laborers arrived at in this study exceed those in Diallo et al. (2010) by 20% and nearly 40% respectively. This is because they are derived independently from separate national data sets.

5. Discussion

Given that fairly stringent criteria are applied to our identification of qualifying work-related injuries, an incidence rate of more than 4%, denominated by all working children, is a matter of concern. This of course applies with equal force to our less stringent measure of all work-related injuries. Some of the injuries to children who are economically active but not engaged in child labor can be prevented, but *all* of the work-related injuries to child laborers are preventable.

It should be noted that the incidence rate of qualifying injuries is higher among child labour workers (4.3%) in comparison with non-child labour workers (3.7%).

From a public health standpoint, there are two appropriate comparisons to make. One is to the risk associated with the activities children would engage in if they were not working. Unfortunately, we do not have sufficient data on general childhood injury events, especially in developing countries, to support a global extrapolation. The other comparison is to injury rates of adults whose labor might substitute for that of children. By substitution is meant not simply the replacement of adults for children in the same tasks, but also reorganization of work processes, including those in the household, which would increase the proportion of total work performed by adults.

This injury rate comparison suggested by this broader interpretation could be approximated by using general adult occupational injury rates in developing countries.

The only study that has generated such an extrapolation is Hämäläinen et al. (2006). Their strategy is to apply ratios of fatal to nonfatal (at least three lost workday) occupational injuries in countries for which they can be computed to the larger set of countries that have national level data only on fatal injuries. The underlying assumption is that fatal injury data are relatively reliable, even in countries with limited record-keeping. The second assumption is that the fatal-to-nonfatal ratio does not differ greatly between developed countries, for which such data are available, and developing countries. Their strategy was to utilize two sets of developed country data to estimate this ratio, one to establish a lower bound and the other an upper. Table 4 summarizes their findings.

Table 4. Adult Injury Estimates for 1998, in Millions and Percent

	Economically Active	Nonfatal (low)	Nonfatal (high)	rate (low)	rate (high)
World	2732.3	182	345.7	6.7	12.7
Developed countries	409.1	8.5	16.2	2.1	4.0
Rest of world	2323.2	173.5	329.5	7.5	14.2

***Source**: Hämäläinen et al. (2006)*

The estimated nonfatal occupational injury rate for adults in developing countries here ranges from about two to three times the qualifying work-related injury rate reported in

Table 3. This is a plausible result. In making this comparison, we should take note of the relatively fewer hours worked by children (our estimated mean is 22.7 per week) and their relative concentration in presumably less demanding tasks. Nevertheless, it is likely that both comparators are underestimated—the adult rates because of the underlying extrapolation assumptions and the child rates because of the likelihood that many of the non-qualifying work-related injuries would have been deemed qualifying had more information on them been available.

As mentioned above, direct comparisons to the global burden estimates are not possible, since the available household survey data do not permit measurement of child impairments in DALY's. Given the large difference in impact between different types of injuries, it would be desirable to have at least one developing country study that offered such measurements. The only existing estimate of DALY's for hazardous child labor is based on an extrapolation from US data. (Fassa, 2003)

A further limitation of the existing data is that they capture traumatically induced impairments triggered by recallable events, but they may undercount impairments due to accumulated traumas, such as musculoskeletal disorders, and they leave out work-related diseases altogether. In addition, they do not address psychosocial outcomes, which may prove to be a consequential source of child (and future adult) impairment. (IPEC, 2011)

Limited as existing child labor injury data are, however, they have the potential to shed light on conditions and practices that place children at heightened risk. The current exercise establishes a head count; future work should employ multivariate methods to identify risk factors. For instance, comparative incidence rates across branches of industry or number of work hours would tell us little in themselves, since hours and activities are likely to covary, and children are not randomly selected into any of these categories. Only by separating the multiple risk factors for which we have data can we draw conclusions about their individual effects. One useful outcome of a such an exercise would be a strengthening of the evidence base for identifying hazardous work in accordance with ILO Convention 182.

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