# Analytic and Strategic Review Paper on

# Employment Conditions as

# Social Determinants of Health

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## Introduction

The analytical focus of this paper is to review evidence on identifying employment conditions both in the external and internal domain of the workplace where interventions are most likely to be effective in improving health and reducing health inequity(Nuwayhid, I.A. 2004). The outer domain of the work place in most of the developing world manifest unemployment, underemployment, poverty, illiteracy, deprivation, malnutrition, unskilled labor, women and children working at very low wages in informal sectors, presence of child labor, bonded agricultural labor, inadequate and polarized land tenure systems, below subsistence level wages, inadequate property rights, unequal distribution of income and political power, increasing polarization of societies (haves and have-nots) and other severe conditions affecting health and health equity (Sen, 2000b; Dasgupta, 2003).. The internal domain or occupational health concerns are largely ignored in the developing world, even though work-related risks resulted in 775,000 deaths world-wide in 2000(Nuwayhid, I.A. 2004). Since employment conditions and occupational health hazards are a systemic problem in developing countries, evidence on interventions will be reviewed from both the external or contextual domain (macro-environment) with structural determinants of employment conditions which encompass larger societal issues of economic development and societal justice with a strong impact on health and health inequity and the internal domain that focuses on the intermediate determinants of the workplace (micro-environment).

In order for this paper to be a useful tool, it is necessary to ask questions as to what interventions and policies acting upon employment conditions in specific settings have been successful in the past to improve health opportunities and or reduce inequities and what did not work so well. Our hope is that with this effort, we will be able to map potential levels of policy action to ameliorate the health effects of pressing employment conditions and reduce health inequity.

It is important to consider the impact of structural or external factors, which play out beyond the level of the individual workplace in society-wide mechanisms or institutions. Employment conditions such as, labor markets**,** the presence of large informal sectors, vulnerable population groups like child labor, bonded labor and illiterate unskilled male and female workers, institutions of worker representation, government regulatory structures, educational systems, and linkages between employment and provision of health services, all shape employment's effects on health and health inequity .

These external factors may act directly by modulating exposure to hazards (as when trade unions or government regulators demand safer working conditions) or access to health care (as when affordable, high quality health care is primarily accessible through employers). They may also act indirectly via impacts on incomes (which in turn

determine access to food, shelter, and other health-related items) or other claims on consumption (notably own-production), or via spillover effects (as when a form of organization, such as a union or producers' organization, provides an effective mechanism for delivery of health education or services in addition to its narrower economic function). The scope of such factors is extremely broad, so we will consider them quite selectively rather than attempting a comprehensive inventory of problems and solutions.

For example, The Pan American Health Organization (PAHO) measured associations between some social variables and exclusion from Health services in Latin America, based on data from five Spanish speaking countries: Ecuador, Guatemala, Honduras, Paraguay and Peru. (PAHO 2005). PAHO identified six variables associated to health services exclusion: 1) Employment and Underemployment, 2) Racial Discrimination, 3) Ethnic Origin, 4)Gender/Age, 5) Geographic Marginalization and 6) Poverty. The summary of the study concludes that the populations with the highest risk of health exclusion were in general: Poor Populations (87%); Populations living in Rural settings (70%) and high level of populations working in the informal sector --independent workers or dependent without job contracts (68%).

Table A. Number and Percentage of Population Excluded from Health Services (Coverage and Access) by Employment and Health Insurance Status (2004 Data)

| | **Peru** | | **Ecuador** | | **Paraguay** | | **Honduras** | | **Guatemala** | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (in 1000s) | % | (in 1000s) | % | (in 1000s) | % | 1in 000s) | % | (in 1000s) | % |
| Informal Sector: Independent Workers or dependent without job contracts | 9,771 | 56%(1) | --- | --- | 2,953 | 64%(1) | 1,306 | 56%(1) | - -- | --- |
| Workers/ Dependents without Health Insurance Coverage | 19,327 | 72%(2) | 9,193 | 77%(2) | 4,507 | 80%(2) | 5,433 | 83%(2) | 9,193 | |

(1) As a percentage of the Economically Active Population (EAP)
(2) As a percentage of the total population

The data in Table A show the percentage of the economically active population described as "Independent Workers" or dependent without job contracts and those excluded from health services (coverage and access) by country studied. This table also illustrates how an employment condition social determinant variable, namely informal sector work, has an impact on the coverage and access to health care of the working population. Since employment conditions also determine the ability of a worker to have access to health insurance, it potentially contributes to the unequal health status of the working population in the informal sector. Workers in the formal sector (with fixed salaries and job contracts) have a higher probability to access health insurance. As table A shows, the high percentage of the general population without health insurance represent millions of people in these five countries. Lack of access to health insurance is generally related to the job status of the head of household and with the health of his/her family. Due to

absence of regulations and lack of surveillance poor safety and health standards and environmental hazards are rampant in the informal sector of the economy. Looking through an analytical lens of health inequity we find that, the interventions to bring about reduction in health inequity and improving of health opportunities are likely to be most effective if we concentrate on the large informal sectors in the labor market.

Another driver in employment conditions that is contributing negatively to health outcomes as well as health inequity for a large segment of workers are the pressures from the globalization of the world's economy that fosters competitiveness seeking higher productivity at a lower cost. Better health and safety standards and appropriate wages are conceived as a barrier to trade. Poor working environment particularly in the informal sector is leading to impairment of health and quality of life for the workers and their families (Forastieri 1992, ILO 1999).

There is extensive evidence that on the one hand, the global economy through the operation of the market mechanism has brought prosperity to many different areas of the world and on the other hand has led to enormous inequality in the distribution of the benefits of the free market. As Sen points out what is needed is not a rejection of the positive role of the market mechanism in generating income and wealth, but the important recognition that the market mechanism has to work in the midst of many institutions that can reduce the inequities in the distribution of wealth and prosperity (Sen, 2000a).

Overcoming these problems in the outer domain is a central part of the exercise of development that involves an integrated analysis encompassing the different interrelated components: economic opportunities (opportunities to participate in trade and production, property rights, access to credit), political freedoms (free speech and elections), social facilities (education and health facilities,), transparency guarantees (right to disclosure and openness) and protective security (social safety net, unemployment benefits, famine relief, emergency public employment) through institutions such as, the state, the market, the legal system, political parties, the media, public interest groups and public discussion groups (Sen 2000b).

The prioritization of the external factors will depend on the feasibility of implementation of the intervention, policy initiative and program in specific settings. The robustness of the association between these employment conditions and their impact on health status across different countries and contexts need to be investigated. Additionally, since our goal is to reduce health inequity, policy makers need to develop strategies for identifying and protecting at risk the vulnerable sub group population with respect to informal sector, child labor, female workers, unskilled and illiterate workers and the migrant labor force. It is clearly evident that a rigorous analysis of employment conditions that would significantly reduce health gradients would imply profound structural changes in the economic system particularly in the context of developing economies.

## Structural Determinants in the External Domain

As we noted in the introduction, we will consider five ways in which external, *structural* strategies targeted at employment can act to solve health problems and contribute toward health equity , as listed in the following grid:

| | **Nature of problem** | **Nature of Interventions/Policy** |
|---|---|---|
| 1) | Exposure to hazards | Collective interventions/regulations in workplace safety and health |
| 2) | Lack of access to health care | Extension of health service access to a wider range of employment states |
| 3) | Insufficient income (or more generally insufficient consumption) related to unemployment/underemployment | Job creation or improvement of job compensation |
| 4) | Vulnerable population (child labor, female workers, illiterate and unskilled labor)/informal sector | Universal Education, Access to credit, Social Entrepreneurship, Foreign aid |
| 5) | Varied health problems | Spillovers from solutions to 1-4. |

In Table 1 (Appendix 1) we reviewed the literature to determine the association between structural determinants in the external domain and their impact on health status. The important findings on several bio-medical studies are listed in Table 1 (Appendix 1).

Table 2 reviews evidence for the effectiveness of solutions focused on external factors. Because of the scale of the interventions (in many cases at the level of entire nations), evidence typically comes from case studies or before-after studies, and many of the results are qualitative (direction of change) rather than quantitative (point estimates of the magnitude of change). Table 3 (Appendix 1), in turn, considers the potential for implementation of the various policy actions. As a guide to the tables, here we briefly discuss each policy, following it through the policy impact in Table 2 as well as implementation potential in Table 3.

In dealing with *exposure to hazards*, collective interventions can create a supportive structural context for implementing many of the solutions to hazards. Two chief collective interventions have proven effective: government agencies charged with monitoring, regulating, and/or conducting education around workplace hazards, and unions or producer associations undertaking similar actions. The two can be particularly effective in combination. In India, for instance, joint action by all levels of government along with trade unions and NGOs (including associations such as the Self Employed Womens Association, SEWA) have significant potential of reductions in industrial accident rates and hazards in working conditions in the informal sector. The scalability and political feasibility of such structural shifts, of course, depends greatly on national and local context. It is easier to extend or strengthen the work of existing agencies or organizations than to establish new ones.

In a number of countries access to health care is tied to formal employment (typically with an inferior health care "safety net" of some kind for those who do not have a family member connected to formal employment. In the most extreme case, providing health coverage is discretionary for employers (as in the United States or private enterprises in China). In these cases *lack of access to health care* can result from

lack of connection to the right type of employer. Effective policy responses typically take place outside the workplace by strengthening the backup safety net, either through reimbursement to entitled individuals (as in the United States) or direct provision of health care (as in Cuba). Cost pressures make it difficult to implement system-wide expansion of the safety net, but targeted provision of services may be easier to undertake, not least because it can be implemented on a variety of scales from local to national.

A review of basic labor statistics for Brazil, India and Mexico, shown below in Table B, demonstrates the seriousness of conditions in the workplace leading to high injury and mortality rates in the mining and manufacturing sectors. It can also be seen that the urban informal sector is large ranging from a share of 19.4% in Mexico to 51.3% in India. Unemployment figures have been excluded from Table B because at 9.7% for Brazil, 4.3% for India, and 2.1% for Mexico, they present an unrealistic picture of actual

**Table B**
**Basic Labor Statistics For Brazil, India, And Mexico**

| | **Brazil** | **India** | **Mexico** | ***Notes*** |
|---|---|---|---|---|
| *Economic activity rate* | | | | BR 2001, IN 2000, MX 2003 |
| Men | 89.1% | 74.5% | 81.1% | |
| Women | 65.8% | 37.9% | 38.1% | |
| Total | 76.0% | 56.7% | 58.4% | |
| *Percentage employed in:* | | | | All 2001 |
| Agriculture | 20.6% | 58.2% | 17.7% | BR includes forestry and fishing |
| Manufacturing | 12.3% | 1.6% | 18.9% | IN includes only *paid* employees in manufacturing |
| Urban informal sector | 27.3% | 51.3% | 19.4% | BR 1997, IN 2000, MX 2000. Based on national definitions |
| *Average weekly hours worked, manufacturing* | 43.2 | 46.7 | 44.4 | BR+IN 2001, MX 2003 |
| *Average earnings per month, manufacturing, US $* | $901.85 | $215.14 | $533.52 | BR 2002, IN 2001, MX 2003. Currency converted using Purchasing Power Parity. |
| *Occupational injury rates per 100,000* | | | | BR 2000, IN 2002, MX 2003. Sources vary. |
| Mining-Fatal | 29.2 | 27 | 65 | |
| Mining-Nonfatal | 2055 | 128 | 10779 | |
| Manufacturing-Fatal | 11.6 | -- | 8 | |
| Manufacturing-Nonfatal | 2460 | -- | 3536 | |

*Sources:* International Labour Organization LABOURSTAT http://laborsta.ilo.org , Table 2.5 of International Labour Organization *World Employment Report 2004-2005* (Geneva: ILO 2005), Census of India http://www.censusindia.net .
*Note:* Definitions may differ across countries.

employment status. According to a recent global estimate of the International Labour Organization (ILO) there are 160 million women and men that are officially counted as unemployed and another billion or more people are underemployed. The vast majority of

the unemployed and the underemployed belong to the developing world. Although the performance of the labor market and the economy in general is assessed in terms of the unemployment rate, the application of the concept is problematic in the context of the developing economies. The presence of a vast informal sector, a high ratio of self-employed, and work organization of surplus labor force in the rural sector that is organized according to traditional arrangements lead to underemployment, low income and low productivity rather than unemployment as normally measured (ILO, 2002) (www.ilo.org, International Labor Organization, *Reducing the Work Deficit: A Global Challenge*, report by the Director-General, 2001).It should be noted that unemployment, underemployment , and lack of job security contribute to increased illness and premature death due to psychological problems such as anxiety and insecurity (Table1 in appendix 1). For those who are working, as job insecurity continues, it acts as a chronic stressor, increasing absences from the workplace and more frequent medical visits. (Wilkinson and Marmot 2003).

There is a major focus in our work on solutions to *inadequate compensation from work* for several reasons. Many health indicators are closely tied to income (WHO 2005a). Furthermore, to the extent that solutions increase the demand for labor (simultaneously increasing the number of jobs and the average compensation of jobs), this increased demand will tend to increase workers' economic and political leverage, facilitating the implementation of other reforms, such as those addressing exposure to hazards or lack of access to care. Compared to other structural strategies, there is an exceptionally broad consensus in favor of creating more and better compensated jobs. In part for all of these reasons, important networks exist that focus on such policies.

The potential problem, however, is that the policy menu and corresponding literature about creation and improvement of jobs are enormous—and contentious! Therefore we limit our attention to a limited menu of reforms that have attracted recent attention in the developing world. Note that we define "increases in compensation" broadly to include increases in own-production for own-consumption, not just wage increases.

A first strategy for increasing compensation is to *increase productivity*. Of course, increased productivity does not in itself assure increased compensation of workers (the value of added output could be claimed by other economic actors), but it certainly can help. Extending and improving education—in the case of developing countries, especially strengthening the coverage and quality of primary and secondary education—is widely recognized as an appropriate policy for boosting productivity, though many have cautioned that increased education will not drive growth in the absence of other factors (Easterly 2001) Many analysts have also advocated technical assistance to smaller firms; in Table 2 we highlight a particular policy package that embeds technical assistance in government procurement conditioned on rising quality and efficiency standards, a combination which seems well suited to propel small and medium sized enterprises (SMEs) along a path of increasing productivity. Whereas educational improvement benefits from significant economies of scale, procurement/assistance policies can function at smaller scales as well.

A second strategy, or set of strategies, targets *access to productive inputs and jobs*. One widely known approach is to increase poor people's access to capital through

targeted microcredit programs. Though there is a heated debate about whether microcredit profitability is consistent with targeting the poorest (Dingue 2005), there is little doubt that micro-lending has succeeded in creating significant earning opportunities among previously marginalized populations. More controversial is the policy of redistributing land through agrarian reform, or productive capital through expropriation of businesses. The current examples of land reform in Brazil and factory takeovers in Argentina suggest that such initiatives can be particularly effective in creating new opportunities for the poor when a movement from below links up with policy changes from above (Lavaca 2004, Spieczny 2004, Tilly and Kennedy, forthcoming, Wright and Wolford 2003). Indeed, an alternative Brazilian land reform initiative implemented *without* movement involvement appears to do little to provide an effective avenue out of poverty (NEAD 1999, Schwartzman 1999). In many situations the effects of land reforms could be pernicious where the government imposes restrictions on land transactions and excludes the peasants from opportunities of the commercial banking system. What the peasantry needs is independent access to capital markets and technical assistance to enable them to negotiate with potential investors (Barkin 1998). In addition to access to productive inputs such as land and capital, in many cases a key element is geographic access to jobs and other income creation opportunities. Expanding mass transit and low-cost transportation options (such as bicycles) are important policy tools in this regard.

A very good example of the contribution of infrastructural development (roads) is provided in a latest *Business Week* article entitled India's Untold Stories (Kripalan 2005). Until recently there were no roads in a district in Maharashtra, India called Khaonda and Jawhar with 650 million people. Villagers were immersed in poverty and children were dying of malnutrition. Most of the villagers worked as migrant workers when the growing season was over and lived in the slums of Bombay with below subsistence level of wages. With the help of a private foundation (BAIF Development Research Foundation) that helped the villages to diversify farming, and through help of the government's tribal Affairs Ministry that gave small cash grants to buy necessary agricultural inputs and the building of roads, the income of the entire district has increased through trade and the grass huts are being replaced by brick homes. It is a model that is worthy of replication in the entire developing world.

Another income-building strategy is fixing a minimum level of compensation. Such a minimum level can be mandated by a government setting a minimum wage, by trade unions or other worker associations, or by pressure from consumer or human rights organizations (perhaps backed up with the threat of a boycott). Such measures are controversial, and in particular there is a concern about reducing the demand for formal labor by increasing its price, reducing employment or shifting employment to the informal sector. However, recent studies (such as Card and Krueger 1995) have demonstrated that when minimum wage levels are low relative to median wages, raising the minimum wage can have negligible or even positive employment effects. Moreover, a higher level of worker rights is positively associated with economic growth (Bivens and Weller 2003). A related but distinct version of this strategy is to target marketing to consumers willing to pay more for higher quality, more environmentally sustainable production methods, or even for higher compensation to producers, for example through

"fair trade" marketing networks. This avoids possible negative impacts on demand, but so far occupies a very small niche within the market.

It is encouraging to see that recently in August 2005, the Indian Parliament has approved The National Rural Employment Guarantee bill which will provide a legal guarantee for at least 100 days of employment every year to every rural household in 200 districts on asset-creating public works programs. It will cost the government Rs 150,000 crores a year ($400 billion) and consist of building the much needed infrastructural projects in the rural sector. The question is: will this program be sauccessful? Given the resource constraint, the govt. can offer only Rs. 60 per worker per day. The wages in the urban area and in well irrigated areas are twice to thrice as much.The short run poses a problem. Expansion of rural infrastructure in the long run might lead to a vast improvement in the quality of rural life in India. Additional funding through other sources e.g. revival of the estate duty or integrating the employment guarantee program with other schemes of rural development might provide the added benefits that are needed for the correct set of incentives(Times of India, 2005). Varsney points out that although market economists think that this program may be wasteful due to the corrupt nature of bureaucracy, there is increasing evidence from other states like that of Rajasthan that the system can work quite well with greater level of scrutiny and accountability. Additionally, in India where the level of illiteracy is very high the masses are unable to participate in the prosperity created by market forces (Varshney 2005). It might be worthwhile to track and assess the impact of the The National Rural Employment Guarantee program on the reduction of poverty in the different districts of India and avoid the repetition of previous failings.

An alternative vision for dealing with the underemployed or those on the fringes of the global economy is offered by Karasek (2004) – developing a broader definition of meaningful work in society that adds the concepts of conducive production to the existing model of commodity production and directly addresses issues of inequity. He urges policy that moves beyond current market-oriented social policies under which any job that cannot be paid for by a free market transaction or survive global competition is considered inefficient or old-fashioned. By facilitating socially useful activity, conducive production expands the boundaries of valid economic activity in society, placing value on needed services that are not commodity-driven. The social processes of conducive production, which focus on human development, are both part of the formula for innovative production and a formula for developing jobs for people at the margins or with disabilities. Good jobs for disabled persons must first carry low health risks, to avoid aggravating the disability and second must prepare the person for other jobs afterwards. The general aim is to increase workers' ability to make significant decisions about planning and carrying out their work, and to build creative collaborations with coworkers supervisors, and customers. Such jobs could also provide (1) a training ground for learning new forms of work coordination; (2) the framework for developing broad skills and socially integrated community functions; (3) services that the larger market economy often provides poorly, such as elderly care, day care, long-term and outpatient health care, and education. Social efficiency defined narrowly would demand the elimination of such jobs, even though the work might have social value. Another effect of globalization

is the creation of precarious employment (Maquiladoras on Free Zone Production Areas) in several sectors of the economy. Industrial production in the new globalized economy has created systems of production in manufacture that are either (1) home-based (Markkanen, 2004), (2) "Free" Investment Zones (Chan, 2003) or (3) Maquiladora Production (Cedillo, 1997), (Harlow, 1999), (Moure-Eraso, 1997). Environmental and Health and safety standards are compromised to stimulate investments for ( 2) and (3) while homework—as described in (1) is becoming the production system of choice in developing countries. The basic premise of the new systems of production is that all the produced goods flow from developing to developed countries. Homework, "free" investment zone work and maquiladora productions are all considered precarious employment with the characteristics of: no-collective bargaining, low wages, uncontrolled exposures, exceptions from regular wage and health and safety regulations and in some cases child labor.

The incidence of child labor is also pervasive throughout the developing world. Africa and Asia account for 90% of the total working children .In India alone, the number of working children estimates range from 65 to 115 million (Human Watch 1996) . Poverty and lack of education have been found to be closely correlated with the widespread prevalence of child labor. Approximately 15 million children work as bonded labor in India. Bonded child labor "refers to the phenomenon of children working in conditions of servitude in order to pay off a debt *The debt that binds them to their employer is incurred not by the children themselves but by their relatives or guardians-usually a parent.*" These debts are relatively modest between $15 to $220. (Human Rights Watch, 1996). It is disconcerting to note that although India has several laws prohibiting the use of child labor and bonded labor, the enforcement of these laws has been weak. A cooperative venture between the Indian government and the ILO, the INDUS project, is aimed at eliminating child labor in the carpet-making industry plus ten hazardous industries in India: cigarette-making; brassware; bricks; fireworks; footwear; bangles; locks; matches; quarried stones; and silk. (US Newswire 2004). The project will be implemented in 20 districts.

The most important findings on occupational diseases pertaining to child labor are listed in Table 1 (Appendix 1). The International Programme on the Elimination of Child Labor (IPEC, 2003) has conducted an integrated study of the costs and benefits of eliminating child labor through out the developing world and has suggested a set of policies to eliminate the problem. The action plan for eliminating child labor and bonded child labor would require a holistic approach and require specific actions on different fronts as specified in Table 2.

To understand the linkage and processes through which structural determinants of employment conditions are manifest in health status inequity, the understanding of the vast informal economy that feeds the poorest and the most disadvantaged and vulnerable group must be deepened. Since most informal activities are unrecorded in published official statistics, it is very difficult to measure the size and rate of growth of this sector It is heartening to note that SEWA in collaboration with two leading research institutions (NCAER and GIDR) – is developing surveys with the National Sample Survey Organization (NSSO) for the improved measurement and understanding of the informal economy in India. As mentioned earlier, a critical issue in the external domain of

employment conditions is to create employment opportunities with adequate and stable earnings. Agriculture in rural areas constitutes the major source of employment in the developing world. However, poverty in the rural areas due to unfair terms of trade, fragmentation of land, lack of access to capital and natural disasters have led to urban migration. This has not led to a proportionate increase in the urban unemployment rate because the migrants have taken up self created employment in the urban informal economy which has led to large scale underemployment (Dasgupta, 2003). The majority of the workers in the urban sector including the rural migrants live in undesirable living and working conditions, which are related to poverty and underdevelopment. Hazardous working and poor living conditions affect their health and make them susceptible to diseases. According to some ad-hoc surveys carried out by the ILO in the Philippines, Nigeria, Senegal and Tanzania the most prevalent health problems in the informal sector were MSD's, low back pain, respiratory diseases, physical strain, fatigue, stress and injuries (Forastieri, ILO 1999). As stated in the World Bank report (Charmes 1998), the informal economy accounts for 60% of urban employment in Africa, between 40 to 60% in Asia and around 40% in Latin America. Women constitute a major proportion of all workers in the informal economy. The informal workforce in India is estimated to be 370 million workers, nearly 93% of the total workforce (including employment in agriculture, informal enterprises, industrial home workers, etc.); women account for one third of the total informal workers (Chen 2003).

There are various success stories of *solutions to inadequate compensation from work* in the informal sector throughout the world that have the potential for scaling up. For example, it is noteworthy to recognize and learn from the role of SEWA in empowering women in different dimensions. "SEWA organizes self employed women to obtain full employment benefits including shelter, health, and child care" (SEWA, 2005). Recently the following incident was narrated to us by Santa Kosti and Mita Parikh of SEWA at the Third Meeting of Commissioners on Social Detrminants of Health (Ahmedabad, India 12-14 September 2005). Informal sector midwives in Gandhinagar district of Ahmedabad received very low wages and worked as casual workers with no licenses. The midwives got together and joined SEWA, attended their awareness and leadership training profram and arranged for a meeting with the minister of the state to explain their plight. The minister advised them to go through a short three day government training program and issued them identity cards (liscence to p[ractice).This enabled them to practice in the organized sector and obtain fair wages. This scheme got scaled up for the entire state of Gujarat and has the potential to be scaled up for the entire nation. There are numerous other examples that can be studied and provide important inputs to the policy making process.

Other evidences of such success stories are also available from different parts of the world. For example, Coopa-Roca, a sewing cooperative in one of the largest slums in Brazil provides flexible employment opportunities to local women from low-income families (PBS). Their success has enabled them to obtain co-op contracts with the European clothes manufacturer C&A. Other Latin American countries are currently investigating similar models. Owing to South and South-East Asia's comparative advantage in sewing, embroidery work and handicrafts the potential for scaling up such

models of cooperatives is substantial. This would require exploring a paradigm shift in how we view the informal sector both in the rural and urban areas and engaging the government to institutionalize a support system for such NGO's.

Clearly there is no single policy that will be able to solve the enormity of the problem in the informal sector. Instead we need an integrated comprehensive policy approach. A working policy framework has been developed by Women in Informal Employment: Globalizing and Organizing (WIEGO) as follows:

"*The overarching policy goals of an informed policy approach should be to: promote informal enterprises – to increase their assets, productivity and competitiveness through a mix of service provision (micro-finance and business development services) and policy interventions; improve informal jobs – to secure the rights of workers through extending the scope of existing legislation, promoting collective bargaining agreements and/ or enforcing labour standards; protect informal workers – to provide insurance coverage for illness, maternity, property, disability, old age, and death through extending existing schemes and/or developing alternative schemes; and promote the 'voice' of informal workers – to promote the organization of informal workers and their representation in relevant policy-making or rule-setting institutions."(Chen* 2003).

An alternative paradigm of autonomous development especially for the rural sector is suggested by David Barkin (Barkin 1998). He states that facets of the current public policy that enhances growth also leads to social inequities especially in the rural sector of the developing world. Hence he explicitly recommends a strategy that would strengthen the economic and social base for an autonomous production system by recognizing and encouraging the marginal groups to create an alternative that would offer them better prospects for their own development. The key to his proposal is *"not a simple transfer of resources to compensate groups for their poverty, but rather an integrated set of productive projects that offer rural communities the opportunity to generate goods and services that will contribute to raising their living standards, and those of their fellow citizens, while also improving the environment in which they live."(Barkin 1998).* He emphasizes the carving out of political spaces that will allow them to exercise their autonomy that will enable them to integrate their indigenous knowledge to guide production for themselves and for commerce with the rest of the society and possibly participate in international trade under more advantageous terms.. The approach requires creation of mechanisms whereby peasants and indigenous communities find support to continue production in their own regions. The strategies proposed were ecosystem management, increased product diversification and regional production of basic necessities. *"Even by the strictest criteria of neoclassical economics , this approach should not be dismissed as in efficient protectionism, since most of the resources involved in this process would have little or no opportunity cost for society as a whole". ."(Barkin 1998).*

Again certain parts of the world are caught in a poverty trap as is evidenced by the falling life expectancy and real percapita income in the Subsaharan regions of Africa. Jeffrey Sachs in his latest book, *The End to Poverty,* recommends a "big push" in terms of infusion of foreign aid (Sachs 2005). The Subsaharan region has a critical dearth of capital and is so overburdened with disease that it can hardly support its growing

population. Aid fuelled investment will generate growth only when the incentives are aligned correctly to foster an appropriate investment climate with policies, regulations and institutions that generate growth with equity. As the World Bank has observed in the past that the West has spent $450 billion in the past on foreign aid and yet it did not fuel growth (Easterly 2002, Economist , 2005).

Finally, it is important to note that structural solutions aimed at improving health and reducing health inequity through the various channels described above—systems to reduce exposure to hazards, to increase health coverage, to create opportunities for stable and adequate compensation, eliminating child labor, promoting informal enterprises and protecting their workers (e.g. social entrepreneurship), strategy for strengthening the rural base of autonomous development and foreign aid —may have positive health spillovers on other areas of life outside the workplace. This is obvious in the case of extending health coverage to additional employment states (such as non-employment). Other spillovers may be less apparent. For example, improved education, which we have introduced as a means to increased productivity, also tends to improve health-related behaviors. Organizations such as unions or producer associations, in addition to mobilizing people for economic purposes, can educate and mobilize them for health purposes—once again, examples of trade unions and Brazil's MST are relevant. We do not explore this set of spillovers in any detail, but it marks a helpful reminder, in closing our discussion of structural factors, that at the level of structure and system the interconnections are many.

The following sections will be published in the next volume along with Tables 4 and 5 which is contained in Appendix 2 and the entire list of references.

## Internal Domain of the Workplace

After a careful review of the literature we have identified specific intermediate determinants in the internal domain namely the seriousness of the workplace hazard (exposure-disease spectrum) and work organizational issues (duration of work, work pressure, forms of payment, etc.) and its impact on health. The health impacts of these factors are found in Table 4 (Appendix 2). Workplace hazards include work organizational issues that impact levels of psychological and physical stress, manual material handling and repetitive tasks that cause musculoskeletal disorders, exposure to chemical hazards, producing acute (short term) and chronic (long term) health effects, and exposure to physical hazards such as excessive noise, along with the risk of fire or explosion. Chemical hazards include solvents, pesticides, and other toxic liquids and mists plus dusts, such as heavy metals, silica, and asbestos which can cause neurological, respiratory and malignant diseases. We have drawn upon the work performed in WHO Task forces 4 and 14 (Lahiri et al. 2002, 2003) to identify interventions in the area occupational back pain and exposure to silicosis in terms of intervention effectiveness and their costs. Results of a representative, literature review have been summarized in Tables 3-4 (Appendix 2) to determine the feasibility of implementation of these

interventions in the context of developing countries in specific settings. Although our primary concern is with health inequity in developing countries, it is often necessary to draw on the experience of developed countries since the literature on interventions in Latin America, Asia, and Africa may not be as readily available in dealing with employment conditions. It is encouraging to note that most of the interventions that were evaluated in WHO Task forces 4 and 14 have been found to be cost-effective even in the developing world. All of the average Cost Effectiveness Ratios for the different interventions, for each of the regions, fall well within their GDP per capita estimates (World Bank, 2001). According to the WHO Commission on Macroeconomics and Health any intervention that costs less than three times GDP per capita for saving a healthy year equivalent should be considered worthwhile and good value for money (WHO, 2002). Given this criterion, the engineering controls interventions as well as the full ergonomics program look very cost effective both for the reduction of the incidence of low back pain and silicosis for all of the WHO subregions (Lahiri et al., 2005a, 2005b).

In this paper, we have focused on identifying from the literature available to date evidence on diseases and injuries related to poor employment conditions in the workplace that result in increased morbidity and mortality. Particular attention is given to work organization issues, including musculoskeletal disorders and psychosocial stressors; exposure to toxic chemicals, including dusts, mists and vapors, exposure to physical hazards such as noise, and exposure to reproductive hazards. Safety issues relating to slips, trips, falls and other injuries are only marginally addressed at this time, although they are a major cause of morbidity and mortality. They can be addressed more fully in the final paper. In this paper, among other things, we document health effects of silica dust exposure and interventions to mitigate or eliminate silicosis. Similar interventions are applicable to other mineral dusts, such as coal dust, as well as to heavy metal dusts such as lead and cadmium. Hazards of construction workers are highlighted in many cases, since it is a high hazard occupation. It should be pointed out that while construction workers are sometimes considered “elite” skilled workers in developed countries, especially if they are unionized, this is work that is often performed by new immigrants at lower wages and with little or no protection in these countries. In developing countries such work is often more dangerous and less controlled.

Agricultural hazards are a major concern in developing countries, especially where this may be the largest work sector. Besides ergonomic hazards and risk of accidents, pesticide exposure is an increasing concern. Pesticides and herbicides are promoted commercially without proper training for workers in many cases. In Costa Rica, where paraquat, an effective herbicide, is widely used , there are no requirement for special training and certification, as there are in the US. Small farmers or individuals can buy it and use it without protection. It should be noted that paraquat is banned in several countries including Finland, Sweden, and Austria. (Schenker 2002) Pesticide exposure is an example of a problem that goes beyond the immediate workplace, since the proliferation of pesticides is related to uncontrolled international distribution of pesticides, even though they may be illegal in the country that exposts them.

Table 4 (Appendix 2) links internal factors with impact on health including work control/psychological demands, intensity of manual material handling, other ergonomic

stressors, silica exposure, exposure to carcinogenic dusts, agent leading to chronic obstructive pulmonary disease (COPD), and noise exposure. Evidence for the association of various intermediate variables and health effects include:

- **Work Organization:** Non-material aspects of health or work organization are increasingly recognized as important contributors to the social gradient of health. In particular psychosocial factors have been found to contribute to coronary heart disease (CHD), musculoskeletal disorders, and mental illness. A high degree of work stress, marked by a high level of psychological demand and a low degree of control also increases absence from work. The effects spill over into into personal life. The evidence of an association between CHD and work organization variables (psychological job demands, job control and effort-reward) shows robust associations. The studies reported in European settings show significant levels of relative risk (Marmot, M., et.al., 1999). These studies show clearly that women have CHD prevalence as high as males. Recent studies conducted in Brazil comparing job strain levels in informal and formal sector workers showed that informal workers are affected by stress as much as office workers. It also demonstrated that the instruments used to measured job strain, such as R.Karasek's Job Content Questionnaire (Karasek and Theorell, 1990) are equally valid for workers in either the formal or informal sector. There are substantial modern studies that relate overtime and shift work to health deterioration. NIOSH from USA published a monograph summarizing 92 studies around the world (Caruso, 2004). The summary results showed that overtime was associated to increased injury rates illness and mortality. One meta-analysis study also showed a possible relationship between long hours of work and preterm birth and sub-fecundity (Tuntiseranee, 1998). This study is summarized in Table1 and is part of the NIOSH monograph.
- **Work Environment Exposures:** A recent two volume publication from WHO summarizes selected occupational health risk factors and disease and injury burden for the estimated 2.9 billion workers exposed to hazardous risks at their workplaces across the world (Concha-Barrientos, WHO 2004) Data were analyzed for the 14 WHO sub-regions globally to examine the disease and injury burden produced by selected occupational risk factors: occupational carcinogens(11), airborne particulates, ergonomic stressors, noise and risk factors for injuries. Lack of reliable data excluded analysis of child labor and other important occupational risk such as: other occupational cancers, reproductive hazards, dermatitis and other skin disorders, musculoskeletal disorders, CHD and stress. Also only a partial analysis of respiratory diseases was conducted due to exposures to Asbestos, silica and coal dust.

  In spite of these unavoidable shortcomings, this is the most ambitious effort in the scientific literature to describe the global burden of occupational exposures for human health. It summarizes the global peer reviewed literature for 14 workplace generated airborne contaminants, evaluating more than 300 studies worldwide. A very condensed summary appears in Table 4. Low back pain and hearing loss are especially important because they have in common the ability to cause substantial disability. Permanent disability has multiple consequences for

the quality of life of individuals and families. The general impact in society is considerable particularly for workers suffering the outcomes at an early age (Ezzati, 2004).

We need to keep in mind that occupational health concerns are largely ignored in the developing world because they mainly occur in the informal sectors of the economy and there are no records of these work related injuries, diseases or fatalities. However, these injuries, diseases and fatalities are preventable by administering appropriate policy interventions (Tables 5). A recent report published by the ILO (Takala 2005) states that there are 2.2 million work-related deaths annually and the extent of underreporting in developing countries is appalling. For example, India reported 222 fatal work accidents in 2001, the ILO estimate for India is 40,100. For nonfatal accidents at work, involving three or more days' absence, India reported just 928 in 2001, compared with a mid-range ILO estimate of 30.6 million. For China the discrepancies are equally staggering, with 12, 736 fatal accidents reported in 2001 against an ILO estimate of 90,300, and 61,330 non-fatal accidents reported against an ILO estimate of 68.9 million (Williams 2005, Takala 2005).This has a huge impact on society not only on the workers and their families but on productivity and profitability of enterprises as well. The ILO report also states that the number of work-related illnesses and deaths appears to be declining in industrialized countries and growing in the developing countries due partly to a shift in employment into safer service occupations away from more dangerous jobs that are being transferred abroad. For example, hazardous substances cause the deaths of some 440,000 workers annually, 100,000 of these from asbestos, the ILO estimate. The ILO attributes this effect to competitive forces of globalization. Again mitigation of these effects would demand urgent attention if we are looking at it through the lens of health inequity.

We have concentrated on identifying interventions and policies relating to internal factors (intermediate variables) mentioned above that would mitigate some of the negative health effects of employment conditions. The goal is to identify and inventory the results of key occupational health interventions and public policies that may have been employed in these areas both in the developed and developing world. It will be useful to evaluate and understand the reasons for success and failure of the interventions from both health and policy-setting perspectives and investigate their impact on health status and health inequity across different countries and contexts. Table 5 (Appendix 2) summarizes a number of interventions and policies, many of which have been successful in mitigating impact on health opportunities and health inequity. Following the WHO concept paper (WHO 2005c), we have identified how each of the interventions proposed would reduce health inequity via: improving the health of disadvantaged population groups through targeted programs; closing the health gap between those in the poorest social circumstances and better off groups; addressing the entire health gradient, that is, the association between socioeconomic position and health across the whole population.

Interventions can include substituting a toxic substance for one that is less harmful, implementing engineering controls, utilizing personal protection, developing programs to mitigate hazards, training workers, involving workers in decision-making. Several references in Table 5 that examine training as an intervention indicate that there was no change as a result of the training (Woolley 1995, Wassell 2000, Mitchell 1994,

Redell 1992, Feldstein 1993, Daltroy 1997, Brown, 1992). Information about the nature of the training, however, is not provided. For example, the training approach - passive vs. interactive- is not discussed.

Other innovative interventions that can prove to be very effective include work organization change, cleaner production, control banding, participatory training for empowerment, coalition-building, and multifaceted approaches.

- **Work Organization Change:** The interventions described in the shadowed area of Table 5, were evaluated in a monograph from the International Labor Office ( ILO, 1992) by Robert Karasek as successful case studies of stress management. The particular interventions consisted of the establishment of anti-stress programs --with full worker participation—that address stress problems as work organization issues. The interventions addressed stress at its source by modifying the work situation rather than by attending only to its symptoms after the fact (Karasek, 1992).
- **Cleaner Production.** Another novel intervention for improving internal (intermediate determinants) is the application of cleaner production strategies to industrial processes that use toxic substances. The examples showed how planned substitutions of toxic chemicals in industrial processes decreased exposures to workers and increased the economic effectiveness of the enterprise. Considerable savings are achieved through lower costs of waste disposal and avoided investment costs in air pollution control equipment (Serra, 1994). There is also the additional advantage of avoiding risk-shifting from the work environment to the general environment (Moure-Eraso, 2000).
- **Control Banding.** A remarkable intervention designed to decrease health impact of work hazards by controlling exposures is described in Table 5 (Bracker, 2005). The study reported applications of a control technology developed by ILO (based in practices of the Health and Safety Executive (HSE) of the United Kingdom) called ILO Safework Chemical Control Toolkit (Control Banding) (ILO, 2005) (Brooke, 1998). This methodology of intervention was adopted jointly by WHO and ILO in 2003 in the form of a “Cooperation on Control” joint effort administrated by the International Programme on Chemical Safety (IPCS) (IPCS, 2003). Control Banding is a simple system of generic risk assessments which leads to the selection of an appropriate control approach. From the control approach, for several common unit operations—for example, mixing, filling, weighing—the user can select an appropriate control through pre-printed handouts, which. provide examples of good practice and give basic descriptions of the controls needed and factors to consider. The purpose of the scheme is to take users straight from hazard and considerations of exposure potential to benchmarks of generally accepted industry standards of good practice (ILO, 2005). In this particular example, reproductive hazards of pregnant workers were addressed by immediate recommendations of interventions to avoid or eliminate exposures (Bracker, 2005). These simply evaluation techniques provide the basis for interventions based on qualitative data. It is highly applicable to developing countries, where it is currently being evaluated. The UML, Department of Work Environment has conducted a workshop in Mexico describing the technology and

applying it for evaluation in local industry of Hermosillo, Sonora, Mexico (Virji, 2005).

- **National and International Coalitions** Nuwayhid (2004) calls for a multi-disciplinary approach to occupational health, beginning with the external domain and moving towards the internal, he stresses the need for those in occupational health to form alliances with unions, NGOs, environmental groups, social scientists, and others – linking occupational health to the broader context of social justice and national development. Such alliances in Brazil have led to the strict regulation of benzene, achieved by a multi-stakeholder agreement between Government, Industry and Labor. This intervention in workplaces using benzene was triggered by a trade union showing that in 1980-85 there were substantial exposures in industry. The Brazilian Ministry of Health reacted in 1994 by forming a tripartite technical work group on benzene. The work group agreed in a collective agreement to comply with governmental orders and normative instructions developed with strong worker participation. This approach is credited with drastically decreasing the incidence of benzene- related disease in Brazil. It is also considered an approach that has a high replication potential and is applicable to other environmental carcinogens (UN Commission on Sustainable Development, 2005). "Silicosis, asbestos-related diseases, lead toxicity, and pesticide poisoning represent striking case studies in which an occupational illness 'stepped out' of the isolation of the workplace and into the realm of environmental and public health concerns, and more importantly, into the general public consciousness." (Nuwhayid 2004 p 1918)( Kipen H.M. 1994). Dusts, which can be carried home to family members, exposing children or community members. Release of toxic chemicals which affect workers and surrounding communities is another example. Use of pesticides by agricultural workers, which affects entire communities, as well as exposures of workers who work in pesticide manufacturing creates a basis for approaching occupational health and employment conditions as an issue of social justice and equity. Building coalitions between consumers, labor unions, and political activists in the developed world to influence the behavior of multinationals in developing countries has been effective in establishing "codes of conduct" and monitoring systems in factories, and has led manufacturers such as Reebok to support the establishment and election of union leaders in their factories in Guangdong, China. (O'Rourke 2003)

  Coalition-building is especially appropriate for issues that cross workplace and community boundaries. The formation of international coalitions to decrease the toll of death and disease caused by materials known to harm workers and communities is an increasingly viable policy intervention. Asbestos banning in the European Union since 1998 is a policy intervention achieved through political coalition building among workers and governments (Gee and Greenberg 2001). In November 2004 the Global Asbestos congress (a gathering of 40 nations) called for a comprehensive global ban of asbestos through regulations in all countries (Landrigan 2005). This kind of intervention requires not only the political

organization of the parties affected in each nation, but also the full endorsement and cooperation for this effort by the international organizations as the WHO and the ILO. Similar international efforts on bans have proven successful intervention strategies to promote health applied to other well known harmful substances created at the point of production. In addition to benzene and asbestos, there are other examples of problem substances amenable to regulations aimed at completely eliminating from society. Banning the use of such harmful substances as crystalline silica-based sand in sand blasting applications, lead in gasoline, or PCBs would be an immediate health improvement for the world community. We are only addressing five substances with incontrovertible evidence of continuous harm to health of the world population. Removal from the human environment may be the intervention of choice for other highly toxic chemicals that affect the workplace and the environment, and thus have a broad impact on human health.

- **Participatory Training :** Training should not be discounted as an important intervention. The type of training, the involvement of workers, and the development of new policies and procedures as part of an overall process are critical components (Freire, P., 1970; Wallerstein, et. al., 1992). The American Journal of Industrial Medicine (22**,** 5, Nov. 1992), in a special issue on Empowerment Approaches to Worker Health and Safety Education, document numerous examples of improvement in knowledge, skills, and application of worker-centered education involving small group problem-solving discussions. This intervention was applied to a number of work settings including workers in Nicaragua and the U.S. who spray pesticides (Weinger, M. and Lyons, M. 1992), to hospital workers using ethylene oxide (La Montagne, 1992.), and to 4,802 public employees trained in hazard communication (Michaels, D. 1992.). The success of the intervention was quantified showing an improvement in knowledge of 27.7%. More importantly, improvement in workplace conditions as a result of training was documented. In all these programs, unions played a significant role in organizing and/or supporting the training. It is important to note that training, carried out as part of a participatory ergonomics team (Evanoff, 1999) demonstrated improvement by reducing injuries and workers compensation costs. Worker Participation: Globalization has brought about investment of major international corporations in developing countries with employment conditions that offer low wages, long hours, and no self determination. Greider (1998), O'Rourke (2003). Media attention and consumer and public concern about "sweatshop" working conditions have resulted in a series of "codes of conduct" related to nongovernmental monitoring systems to improve conditions even in areas with weak government enforcement. Many believe that workers and local organizations are the best monitors. According to O'Rourke, "Worker participation is critical for improving labor conditions and practices in China. Workers should be involved in the verification of conditions inside factories through safe compliant procedures, protection of their right to stop dangerous conditions, the establishment of health and safety committees, and ultimately the creation of unions that are responsive to their needs and concerns." (O'Rourke

2003) A project brought together international footwear manufacturers, labor rights groups, local contract factories, and occupational health professionals to strengthen factory health and safety programs in Southern China. A key component of this project was training of workers to recognize hazards and to build their capacity to fully participate in tripartite health and safety committee consisting of workers, management and local NGOs. The project significantly increased occupational health and safety knowledge and resulted in identifying and correcting many hazards in factories. (Szudy 2003)

- **Multi-faceted Approaches:** Multi-faceted holistic approaches have also been proven to be successful in addressing various hazardous employment conditions. For example, in a program to mitigate HIV among sex workers in India, a multifaceted approach was used, involving community education and individual counseling, as well as addressing environmental barriers and resources, and improving skills and competencies related to HIV prevention and treatment as depicted in Table 5 (Appendix 2).

  It should be noted that while personal protective equipment (PPE) is often viewed as a quick fix that can be widely used and easily scaled up, some PPE, such as back belts, are not effective as evident in Table 5 (Appendix 2). While hearing protection is effective, there is a wealth of research attempting to get workers to actually use it. Other options, which can also be scaled up and used widely, such as substitution, clean production, control banding, and interactive training combined with substantive worker input need to be closely examined as well.

## Conclusion

Some of these upstream fundamental issues either in the external or the internal domain might require carrying out the extremely complex task of socio-economic transformation relating to the politics of institutional structures and resource allocation. Therefore, we plan a fourfold strategy that focuses on policy action regarding more tractable factors, but emphasizes the links between these factors and broader, more entrenched aspects of the socioeconomic context. The elements of this fourfold strategy are:

1. Maintain a goal orientation toward concentrating on those internal and external factors in employment conditions that are modifiable through the application of somewhat straightforward interventions or policies to improve health given some of the constraints of the system.

2. Frame this orientation within a broad and integral understanding of the range of socioeconomic factors that shape work, earnings, and health.
3. Promote long-term linkage between immediate steps and more systemic change. In particular, explore and encourage actors in these countries to leverage the power and consciousness garnered in limited interventions, in order to take on broader challenges over time.
4. Promote sustainable interventions and policies that are affordable and promote long-term sustainability and improved health.

Finally, the goal should be to translate the scientific findings into effective policy making for implementation (via a communications, change management and policy-setting plan). Efforts should be made to help support policy makers in identifying and managing the activities that are required for a smooth transition from the current state to the desired state.

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## Appendix 1: Conditions of Work External Factors (Structural Determinant)

**Table 1:** Association between External Factors (Structural Determinant) and Impact on Health

**Table 2:** Analysis of External Interventions and Policies to Mitigate Impact on Health Opportunities and Health Inequity

**Table 3:** Potential for Implementation of External Interventions and Policies for Developing Countries

**Table 1**
**Association Between External Factors (Structural Determinant) and Impact on Health**

| Structural Determinants | Health Impact | Impact on Productivity | Citation |
|---|---|---|---|
| Widespread Unemployment/ Underemployment (Poor formation of Human Capital: symptom of poverty) | Stress, Depression, Coronary Diseases and premature death from feelings of insecurity and financial problems | Loss of production due to unutilized, under utilized labor and sickness | Wilkinson(2003)<br>Beale (1985)<br>Bethune (1997)<br>Burchell (1994)<br>Ferrie (1999)<br>Iversen (1987)<br>Dasgupta (2003)<br>Ginsberg (2005) |
| Workforce at risk of Malnutrition due to Unemployment/ Under employment and Low Wages | Weakened Immune System ;<br>Morbidity;<br>Nutritional Anemia; fatigue; low life expectancy. | Low productivity/ future capability of the workforce | Berg (1987)<br>Royston (1982);<br>Scrimshaw(1968,1970, 1982,1983,1984);Levin (1986);<br>Spurr (1983,1984,1988,1990, 1977,1978)<br>Dasgupta (2003) |
| Extreme neglect of literacy : Illiterate and Poorly Educated Manual Workers including Female workers | Poverty related health impacts; 2.Less Awareness of Health Hazards in Working Conditions lead to injuries and occupational diseases | Low productivity | Sen (2000)<br>Dreze and Sen (1995) |
| Weak Labor Regulations and Labor Unions | Exposure to hazardous work and insufficient income to meet basic needs | Low productivity | Wiel, D. (2001) |
| Child Labor/Bonded Child Labor | Stunted growth, Anemia, Respiratory and Neurological, diseases; muscular deformities ; Physical Abuse | Low productivity;<br>Loss of future growth potential for future generation of workers | Hawamdeh (2001);<br>Shah P.M. (1984); Feingold and Wasser(1994); Satyanarayana (1985);<br>Joshi (1996);<br>Forastieri (1992); Conley (2000); |

| Table 1<br>Association Between External Factors (Structural Determinant) and Impact on Health | | | |
|---|---|---|---|
| **Structural Determinants** | **Health Impact** | **Impact on Productivity** | **Citation** |
| | | | |
| High Fertility Rates | Low quality of life and associated health problems | Low savings, low investment and low productivity; Loss of future growth potential | Dasgupta (1988, 1989,1991); Parfit (1982, 1984. 1990); World Bank (1984) |
| Poverty/Informal Sector | Health Risk factors as a function of socio-economic status | low | WHO, Blakely (2004) World Bank (1990) |
| Poor OSH Standards | Industrial Accidents/ Injuries | Negative due to sick leave, disability and absenteeism | Gupta in Stellman (ILO, 1998) |

| Table 2 Analysis of External Interventions and Policies to mitigate Impact on Health Opportunities and Health Inequity | | | | |
|---|---|---|---|---|
| **Structural Determinant** | **Intervention/Policy** | **Potential Impact on Health Inequity** | **Comments** | **Evidence** |
| Exposure to a variety of workplace-based hazards | Creation or strengthening of government monitoring and/or regulatory agencies to inform workers and/or require employers to mitigate hazards. Example: • Establishment of NSC (National Safety Council) and • National Safety Day (Week) Campaign since 1972/India and improved OSH government policy | Health gradient | 65% reduction in accident rates between 1971 to 1992 (India) | Gupta in Stellman (ILO, 1998) |
| | Creation of the National Institute for the Improvement of Working Conditions and Environment (NICE) in Thailand • 10 regional centers were established | Health gradient | | Yingratanasuk (1998) |
| | Improving OSH standards in the tanning industry in South East Asia • "know-how through show how" principle (India, Indonesia, Nepal and Sri Lanka) | Health gradient | Improved profit and cost savings; Positive assessment in awareness creation and tanners proactive response; entrepreneurs acted as advocates of the cause. | Hannak (1998) |

| Table 2 Analysis of External Interventions and Policies to mitigate Impact on Health Opportunities and Health Inequity | | | | |
|---|---|---|---|---|
| **Structural Determinant** | **Intervention/Policy** | **Potential Impact on Health Inequity** | **Comments** | **Evidence** |
| Exposure to a variety of workplace-based hazards (continued) | Action by trade unions or producer associations to educate workers or demand mitigation by employers Examples: • Trade union and NGO involvement in safety campaigns noted in 1.1 • SEWA involvement in implementing and popularizing use of nylon gloves by tobacco workers | Health gradient | | NIOH website Saiyed (2006) Fingerhut(2006) http://icmr.nic.in/000004/project1/project.htm |
| Lack of access to health care | *Large scale* extension of health care to more employment states (including non-employed states). Examples: • (Positive) U.S. creation of Medicare (health coverage for the elderly) and Medicaid (health coverage for the poor) in the 1960s. • (Negative) China's decrease, from the 1980s forward, in state employment with guaranteed health coverage, and expansion of private employment | Health gradient | Varies; tradeoff between improved individual productivity (Behrman 1999, pp.2893-2901) and socially borne costs | U.S. : U.S. Dept. of Health & Human Services (2000), Smith (2002). China : Schoepfle (1996) |

| Table 2 Analysis of External Interventions and Policies to mitigate Impact on Health Opportunities and Health Inequity | | | | |
|---|---|---|---|---|
| **Structural Determinant** | **Intervention/Policy** | **Potential Impact on Health Inequity** | **Comments** | **Evidence** |
| Lack of access to health care (continued) | *Smaller scale* extension of health care to more employment states<br>Examples:<br>• Brazil's Unique Health Care System (2000s: community clinics including occupational safety and health component, serving all regardless of employment state)<br>• Cuba's community-based polyclinics and family doctors (1960s forward) | Health gradient | Varies; tradeoff between improved individual productivity and socially borne costs | Cuba:<br>Díaz and Fernández (1989) |
| Inadequate compensation (due to unemployment or under-employment) | Increase contributions to productivity by extending and improving education | Health gradient | Increased education leads to increased incomes: Behrman 1999 2910-2915, Card 1999, Easterly 2004.<br>Education does not lead to growth in the absence of other factors: Easterly 2001, Ch.4.<br>Effective policies for improving education in developing countries: Glewwe 2002 | Behrman (1999)<br>Easterly (2004)<br>Glewwe (2002) |

| Table 2 Analysis of External Interventions and Policies to mitigate Impact on Health Opportunities and Health Inequity | | | | |
|---|---|---|---|---|
| **Structural Determinant** | **Intervention/Policy** | **Potential Impact on Health Inequity** | **Comments** | **Evidence** |
| Inadequate compensation (due to unemployment or under-employment) | Improve productivity of small businesses by government procurement tied to increasing standards, supported by technical assistance<br>Example:<br>• Procurement by state government of Ceará, Brazil | Targeted | | Tendler and Amorim (1996) |

| Table 2 Analysis of External Interventions and Policies to mitigate Impact on Health Opportunities and Health Inequity | | | | |
|---|---|---|---|---|
| **Structural Determinant** | **Intervention/Policy** | **Potential Impact on Health Inequity** | **Comments** | **Evidence** |
| Inadequate compensation (due to unemployment or under-employment) Continued | Improve poor people's access to capital via microcredit programs through Credit programs; Credit Cooperatives Examples:<br>• Grameen Bank (Bangladesh)<br>• BancoSol (Bolivia)<br>• Bank Rakyat Indonesia Unit Desa | Targeted | Problems of Moral Hazard and Adverse Selection require screening and monitoring of workers | Review in Dingue (2005)<br>Grameen Bank Bangladesh Hossain (1984) |
| | Improve poor people's access to capital or land via redistribution. Examples:<br>• Movimento sem Terra (MST, Brazil)<br>• Recuperated enterprises (Argentina) | Gaps Reduced | Redistribution can be particularly effective when bottom-up movements link with top-down reforms | Land reform can be effective in contributing to more equal incomes and faster growth: Fields 2001, de Janvry et al 2001, de Janvry and Sadoulet (2002).<br>MST case: Meszaros (2000), Wright and Wolford (2003).<br>Argentina case: Lavaca 2004, Spieczny (2004), Tilly and Kennedy forthcoming |
| | . Improve poor people's access to jobs or income creation opportunities via transportation | Health Gradient | | GTZ(2005) |

| Table 2 Analysis of External Interventions and Policies to mitigate Impact on Health Opportunities and Health Inequity | | | | |
|---|---|---|---|---|
| **Structural Determinant** | **Intervention/Policy** | **Potential Impact on Health Inequity** | **Comments** | **Evidence** |
| | Raise low wages by setting minimum compensation standards for jobs<br>Examples:<br>• National or regional minimum wage<br>• Collective wage bargaining by trade unions<br>• Pressure by consumer and human rights groups (anti-sweatshop campaigns, corporate codes of conduct)<br>• Collective marketing by producer associations | Health Gradient | Raising wage or price can lead to decreases in quantity demanded and may have a contractionary impact on the economy | Greater worker rights associated with faster growth: Bivens and Weller (2003).<br>Minimum wage can raise incomes without major disemployment effects: Card and Krueger 1995.<br>Unions raise wages and have equalizing effects: Freeman and Medoff 1984, Fairris (2004).<br>Sweatshop monitoring can be effective but is difficult: O'Rourke (2001).<br>Collective marketing through "fair trade" channels can increase incomes: TransFair USA (2005). |
| Widespread Unemployment/ Underemployment (Poor formation of Human Capital: symptom of poverty) | Establishment of an employment guarantee program (Dasgupta 2003): Food-for-work/ cash-for-work for the production of public goods (Berg, 1987; Dreze and Sen (1990); World Bank 1990) | Improving the health of vulnerable groups through targeted programs**.** | **Problem of Incentives:** Badly managed and unproductive public investments may retard growth; (Basu 1981;Dev1992); | Public Employment – South India (Ravallion 1991)<br>Employment guarantee scheme in Maharastra Ravallion (1991)<br>Food aid - Srinivasan (1989) |
| | Government Public Works Project with Community Participation ( user oriented design and management )[1](Gambetta 1988, Seabright 1990) | Health gradient; | Community participation may be hindered due to lack of working capital for private individuals without assets | Rural Piped Water Project Malawi World Bank (1989); |
| Poverty: Workforce at risk of Malnutrition due to | Targeted Food Subsidy (Dasgupta 2003): | Improving the health of vulnerable groups | Problem of Incentives: Adverse Selection and | Brazil Nutrition Research and Development Project Berg, A (1987) |

| Table 2 Analysis of External Interventions and Policies to mitigate Impact on Health Opportunities and Health Inequity | | | | |
|---|---|---|---|---|
| **Structural Determinant** | **Intervention/Policy** | **Potential Impact on Health Inequity** | **Comments** | **Evidence** |
| Unemployment/ Under employment and Low Wages | Tagging/Location; Containment of Illegal Side Markets; Scheme of "Self Selection"(Akerlof ,1978; Diamond &Mirlees,1971, Hahn, 1973); Comprehensive nutrition and health services in India | through targeted programs | Moral Hazard, Golding et. al (1983); Rise of Illegal Side Markets; discourages incentive to work (Besley et al 1992; Pellekaan 1986)); Shortage of Trained Nutritionists(Berg,1987) | Projects in Indonesia, Colombia; Tamil Nadu Subbarao (1989); Subsidized Food at publicly Controlled Stores, "Rationing" (India) Reutingler and Pellekaan (1986) |
| Extreme neglect of literacy : Illiterate and Poorly Educated Manual Workers including Female workers | Allocation of Funds for Basic Primary and Secondary Education/ Vocational Education with particular emphasis on Female Education (L Summers 1992 (Mulholland 1999) | Health Gradient | Unutilized Opportunities | Success of Universal Free Education in Sri Lanka (Fernando 2000, Marga Inst. 1984, Gunatilleke1 (984). Costa Rica Halstead et.al (1985) Cuba (Spiegal,2004 Diaz-Briquets 1983, Nayeri (1995) |
| Child Labor/Bonded Child Labor | Holistic Approach: Enforcement and Prevention: Employers need to be prosecuted (HRW1996) ; Rehabilitation of children from bonded labor, forced prostitution and hazardous work ILO 2003, HRW 1996) ;Expansion of School Capacity and upgrading of School Quality (ILO 2003); free schools with meals; | Improving the health of vulnerable groups through targeted program; Health gradient because of enhanced productive capacity of the future work force. | | ILO:IPEC (2003) |

| Table 2 Analysis of External Interventions and Policies to mitigate Impact on Health Opportunities and Health Inequity | | | | |
|---|---|---|---|---|
| **Structural Determinant** | **Intervention/Policy** | **Potential Impact on Health Inequity** | **Comments** | **Evidence** |
| Child Labor/Bonded Child Labor (continued) | Income transfers to Families with Child labor to compensate income loss for transferring children to school; Vocational training, popular education to change views of parents; International institutions (WHO) need to campaign to demonstrate the adverse health consequences of child labor and international lending institutions can require compliance with the legal prohibitions of bonded and child labor | | Poor Enforcement of Regulations. Corruption among government officials; Underreporting of incidence of child/bonded child labor by state governments in India ; Financial burden on the Public Sector; Mobilization of resources; education is complicated | Brazil's Bolsa Escola (ILO 2003) Siddiqi Guatamela Success Story Richards 1988; Ilon (1991)A Case Study of Rural Peru Patrinos (1995)Education and Child Labor in Paraguay Seetharamu (1985)Constraints and Prospects of Child Labor in India Community-based Savings and Credit Programs for parents North Arcot District in India |
| Informal Sector | 1994 ILO Interdepartmental Project on the Informal Sector: Comprehensive Approach to<br>• Gradual application of protective national and international regulations<br>• Development of basic forms of access to health care through mutual funds<br>• Improvement of safety and health standards<br>• Development of | Health Gradient | Low level of literacy of the target group; lack of: low cost training materials; adequately trained resource persons; commitment from government authorities; health care delivery mechanisms; information and data | Dares Salaam in Tanzania (Training Programs and Health Insurance Schemes to reduce occupational hazards); Philippines (Micro enterprises emphasizing productivity and credit) - (Forastieri, 1999); |

| Table 2 Analysis of External Interventions and Policies to mitigate Impact on Health Opportunities and Health Inequity | | | | |
|---|---|---|---|---|
| **Structural Determinant** | **Intervention/Policy** | **Potential Impact on Health Inequity** | **Comments** | **Evidence** |
| | Management Skills<br>• (4) Capacity Building | | | |
| Varied health problems<br><br>Varied health problems (continued) | Health spillovers outside of work from policies designed to address problems 1-4.<br>Examples:<br>• Improved education leads to better health-related behaviors outside work<br>• Organizations that pursue economic goals can also mobilize or educate people for health goals (for example, Brazilian communities organized by the MST set up clinics, carry out public health campaigns | Health Gradient | | MST case: Wright and Wolford 2003 |

**Table 3 Potential for Implementation of External Interventions and Policies for Developing Countries**

| SDH Variable | Intervention/Policies | Work/Workplace Modification Potential: | Potential for Scaling up | Political Feasibility | Comments |
|---|---|---|---|---|---|
| Exposure to a variety of workplace hazards | 1. Creation or strengthening of government monitoring and/or regulatory agencies to inform workers and/or require employers to mitigate hazards | High | Varies; Functions best at large scale | Limited | |
| Exposure to a variety of workplace hazards | 2. Action by trade unions or producer associations to educate workers or demand education by employers. | High | Varies; Functions best at large scale | Varies | Depends on strength of organizations |
| Lack of access to health care | 1. Large scale extension of health care to more employment states | High (typically involves expanding or supplementing health benefits received through work) | Varies; functions best at large scale | Small | |
| Lack of access to health care | 2. *Smaller scale* extension of health care to more employment states | High (typically involves expanding or supplementing health benefits received through work) | High | Moderate | |
| Inadequate compensation (due to unemployment or under-employment | 1. Improve education | High but delayed | High | Moderate | Depends on level of class polarization |

| | | | | | |
|---|---|---|---|---|---|
| Inadequate compensation, continued | 2. Improve productivity of small businesses by government procurement tied to increasing standards, supported by technical assistance | High | High | Moderate | |

**Table 3 Potential for Implementation of External Interventions and Policies for Developing Countries**

| SDH Variable | Intervention/Policies | Work/Workplace Modification Potential: | Potential for Scaling up | Political Feasibility | Comments |
|---|---|---|---|---|---|
| Inadequate compensation, continued | 3. Improve poor people's access to capital via microcredit programs. | Moderate | Debatable | High if limited in scale | |
| Inadequate compensation, continued | 4. Improve poor people's access to capital or land via redistribution. | High | High in technical terms, low in political terms | Low | |
| Inadequate compensation, continued | 5. Improve poor people's access to jobs or income creation opportunities via transportation | Moderate | High | Moderate | |
| Inadequate compensation, continued | 6. Raise low wages by setting minimum compensation standards for jobs | Varies (depends on balance between wage effects and negative employment effects) | High in technical terms, low in political terms | Low | |
| Varied health problems | 1. Health spillovers from policies designed to address problems 1-4. Examples: Improved Education leads to better health-related behaviors outside work; Brazilian communities organized by clinics carry out public health campaigns. | Varies | Varied | Varied | |

* These potentials are context specific and vary from country to country

## Appendix 2: Employment Conditions Internal Factors

**Table 4:** Association Between Internal Factors (Intermediate Variable) and Impact on Health

**Table 5:** Analysis of Specific Interventions and Policies to Mitigate Impact on Health Opportunities and Health Inequities

| Table 4. Association Between Internal Factors (Intermediate Variable) and Impact on Health | | | | | |
|---|---|---|---|---|---|
| **SDH Variable (Intermediate Variable)** | **Economic Sector/Country: informal/formal** | **Linkage to Health Outcome** | **Socioeconomic Position: 1.vulnerable group; 2. white collar, skilled workers** | **Evidence Based Citations** | **Comments** |
| Psychological Work Demands<br>Work Control | Comparison of Brazilian Informal and Formal Sector workers (780/ 408) Brazil | Statistically equal degrees of job strain in both groups | 1.Street Vendors compared to<br>2. Office Workers | Araujo, Karasek (2003) | Cross section study<br>City of Salvador , Bahia, Brazil |
| Psychological Work Demands<br>Work Control | 10,308<br>Civil Servants<br>UK | CHD<br>Cardiovascular: Angina/Ischemia<br>RR = 1.93 CHD assc. low job control | 1. 33% women<br>2. White Collar (35-55 age) | Bosma et al (1997) UK | 5 year study<br>Adjusted by: Age, blood pressure, cholesterol, mass index, job grade |
| Physical strain<br>Work Control<br>Job variety | 902 Finnish<br>Factory Workers<br>Finland | Fatal / Non-Fatal CHD<br>RR = 4.95 CHD assc. low job control & Physical strain | 1. 33% women<br>2. Blue Collar (20-62 age) | Hann (1988) | 1 year study<br>Adjusted by: age, smoking, weight, cholesterol, blood pressure |
| Hectic work<br>Low learning potential | 958,096 Swedish<br>Active workers<br>Sweden | Non-fatal Myocardial Infarction<br>RR= 1.5 | 1. 51% women<br>2. Whit/blue collar (20-64 age) | Alfredsson, et al (1985) | 1 year study<br>Adjusted by: age, 10 social levels,demographic factors, smoking, heavy lifting |
| Extended Shift Work (>71 h/week) | 907 couples. Pregnant women and partners. Women employed before pregnancy<br>Thailand | Sub-fecundity (Infertility, difficulty to become pregnant)<br>OR = 2.3, OR = 4.1 if men do overtime work | 1.100% women<br>2. White/blue collar Women and men salaried workers | Tuntiseranee (1998) | Reproductive Study<br>Adjusted for primigravid pregnancies, age, education, weight, medical history, menstrual regularity |
| High effort, low reward | 416 German<br>blue collar workers<br>Germany | Fatal/Non-fatal CHD<br>RR = 6.15 | 1. 100% male<br>2. Blue collar | Siegrist (1990) | 6.5 year Prospective Study.<br>Adjusted by:<br>age, smoking, , blood pressure, cholesterol |

| Table 4. Association Between Internal Factors (Intermediate Variable) and Impact on Health | | | | | |
|---|---|---|---|---|---|
| **SDH Variable (Intermediate Variable)** | **Economic Sector/Country: informal/formal** | **Linkage to Health Outcome** | **Socioeconomic Position: 1.vulnerable group; 2. white collar, skilled workers** | **Evidence Based Citations** | **Comments** |
| Overcommitment<br>High effort, low reward | 5720 Swedish<br>Active workers<br>Sweden | Hypertension<br>RR(men) = 1.62<br>High LDL Cholesterol<br>RR(women) = 1.39 | 1. 44% women<br>2. White/blue collar | Peter et al (1998) | Prospective study<br>Adjustment by:<br>Age, smoking, exercise, weight |
| Silica Exposure | Construction (sand blasting, concrete work) mining, foundries, quarries<br>USA | Silicosis | 1. Construction workers in developing countries;<br>2. Construction workers, USA | Lahiri, et al 2002<br>Wagner, 1995, 1997<br>Linch, 1994<br>Linch 2002<br>Saiyed, 1997 | A world-wide problem.<br>China, Vietnam, Singapore, Thailand and India have national action plans.<br>In US NIOSH recommends reducing PEL by 50% to .05 $mg/m^3$. |
| Intensity of manual material handling – postures - repetition | Construction, health care, assembly line operations, clerical – CRT - use | Low back pain, injured joints, inflammation-musculoskeletal disorders (MSDs) | 1.Low level health care workers, assemblers<br>2. Construction workers, developed countries | Lahiri, et al 2002<br>Cohen, et al, 1994<br>Linton, 2001<br>NIOSH, 1997<br>OSHA Guide, 2000<br>ILO, 1996<br>National Research Council, 2000 | Wide-raging problem resulting in lost days, pain, chronic injury, and sometimes loss of ability to work. |
| Hazardous Work Conditions | Blue Collar workers in 14 WHO Sub-Regions in 5 continents | Unintentional Injuries<br>Leading cause of occupational death<br>(317,000 estimated cases)<br>11,000,000 years of healthy life lost | 1.Blue Collar Workers;2 White Collar<br>Ratio of death male/female:<br>5/1 | Ezzati, et al WHO-2004 | Major cause of death and disability<br>Most data peer reviewed scientific journals<br>Relative Risks and confidence Intervals calculated for each WHO sub-region |

| Table 4. Association Between Internal Factors (Intermediate Variable) and Impact on Health | | | | | |
|---|---|---|---|---|---|
| **SDH Variable (Intermediate Variable)** | **Economic Sector/Country: informal/formal** | **Linkage to Health Outcome** | **Socioeconomic Position: 1.vulnerable group; 2. white collar, skilled workers** | **Evidence Based Citations** | **Comments** |
| Exposure to Carcinogens (As, Be, Cd, Cr, Ni, Silica and Asbestos) | Blue Collar workers in 14 WHO Sub-Regions in 5 continents | 9% occupational risk factor: Lung Cancer (100,700 estimated deaths)<br>2% occupational mortality burden Leukemia | 1,2Ratio of death male/female: 5/1 | Ezzati, et al WHO-2004 | Most data peer reviewed from scientific journals<br>Relative Risks and confidence Intervals calculated for each substance for each WHO sub-region |
| Agents Leading to Chronic Obstructive Pulmonary Disease (COPD) | Blue Collar workers in 14 WHO Sub-Regions in 5 continents | 13% occupational risk factor: COPD (310,000 estimated deaths)<br>3,740,000 years of healthy life lost | 1,2<br>Ratio of death male/female: 5/1 | Ezzati, et al WHO-2004 | Second major cause of death and disability<br>Most data peer reviewed from scientific journals<br>Relative Risks and confidence Intervals calculated for each substance for each WHO sub-region |
| Ergonomic Stressors (vibration, heavy lifting) | Blue Collar workers in 14 WHO Sub-Regions in 5 continents | 37% occupational risk factor: Low Back Pain | 1.2<br>Ratio of death male/female: 5/1 | Ezzati, et al WHO-2004 | First risk factor for disability<br>No MSDs considered in analysis<br>Most data peer reviewed from scientific journals<br>Relative Risks and confidence Intervals calculated for each WHO sub-region |
| Noise Exposures | Blue Collar workers in 14 WHO Sub-Regions in 5 continents | 16% occupational risk factor: Hearing loss<br>4,180,000 years of healthy life lost | 1.2<br>Ratio of death male/female: 5/1 | Ezzati, et al WHO-2004 | Second risk factor for disability<br>Most data peer reviewed from scientific journals<br>Relative Risks and confidence Intervals calculated |

* These potentials are context specific and vary from country to country

**Table 4. Association Between Internal Factors (Intermediate Variables) and Impact on Health**

| SDH Variable (Intermediate Variable) | Economic Sector/Country: informal/formal | Linkage to Health Outcome | Socioeconomic Position: 1.vulnerable group: illiterate workers, women, children 2. white collar, skilled workers | Evidence Base Citations | Comments |
|---|---|---|---|---|---|
| Exposure to dust containing free crystalline silica (60%) in the grinding process | Agate Industry/ India/Cottage and Household Industry | Silicosis and Tuberculosis ( Family Members of Employees were also exposed to silica) | Male and Female Workers and Child Labor in rural areas of Gujarat and Rajasthan | NIOH website Saiyed (2006) Fingerhut(2006) Das (1992) http://icmr.nic.in/000004/project1/project.htm | Silicosis occurs within 5 years of exposure |
| Exposure to air borne silica dust in cutting slate stone | Slate Pencil Industry/Cottage Industry/India | Silicosis and Premature death | Male workers in rural areas of Mandsaur district of Madhya Pradesh | NIOH website | Airborne silica dust levels are several times higher than the limits prescribed by regulations |
| Exposure to 100% free silica in Quartz grinding | Quartz crushing units for making glass, potteries, ceramics etc. /India | Silicosis occurs within a few months of exposure | Male workers | NIOH website | Airborne silica dust levels are several times higher than the limits prescribed by regulations. |
| Exposure to silica dust | Stone Quarries | Silicosis | | NIOH website | Epidemiological Survey results showed that silicosis occurred after 10 yeas r of exposure |

**Table 4. Association Between Internal Factors (Intermediate Variables) and Impact on Health**

| SDH Variable (Intermediate Variable) | Economic Sector/Country: informal/formal | Linkage to Health Outcome | Socioeconomic Position: 1.vulnerable group: illiterate workers, women, children 2. white collar, skilled workers | Evidence Base Citations | Comments |
|---|---|---|---|---|---|
| Silica Exposure | Construction (sand blasting, concrete work) mining, foundries, quarries | Silicosis | 1,2 | Lahiri, et al 2002 Wagner,1995, 1997[i] Linch, 1994 Linch 2002 Saiyed, 1997 | A world-wide problem. China, Vietnam, Singapore, Thailand and India have national action plans. In US NIOSH recommends reducing PEL by 50% to .05 $mg/m^3$. |
| Exposure to Asbestos | Asbestos Cement Industry/Asbestos yarn and ropes/Asbestos mining and milling/India | Asbestosis, lung cancer | Male workers/ Andhra Pradesh, Rajasthan | NIOH website | Epidemiological studies were carried out in four asbestos cement factories: prevalence of asbestosis varied between 3% to 5% |
| Exposure to Cotton, flax and hemp dust | Cotton Textile Industry/India | Lung Disease - Byssinosis | Male workers (unskilled) | NIOH website | Epidemiological studies were carried out which showed 30% to 38% prevalence rate. |
| Underground Coal Mining | Coal mining | Pneumoconiosis and other Respiratory Morbidities | Male workers (unskilled) | Mukherjee 2005 NIOH website | 9 coal mines of Eastern India were studied1988-91. |
| Noise Pollution | Textile/fertilizer/oil and natural gas/pharmaceutical firms | Hearing loss, mental Fatigue, reduced alertness and irritability | Male workers (skilled and unskilled) | NIOH website | Production efficiency increased with hearing protection devices. |
| Noise | US, Australia, Taiwan Construction workers, miners | Hearing loss | (skilled and unskilled) | NIOSH website | |

**Table 4. Association Between Internal Factors (Intermediate Variables) and Impact on Health**

| SDH Variable (Intermediate Variable) | Economic Sector/Country: informal/formal | Linkage to Health Outcome | Socioeconomic Position: 1.vulnerable group: illiterate workers, women, children 2. white collar, skilled workers | Evidence Base Citations | Comments |
|---|---|---|---|---|---|
| Physical stress in Drilling ; Daily long distance travel on rough roads to work sites | Oil and Natural Gas Industry/India | Low Back pain and back injuries | Male workers in the outskirts of Ahmedabad City ((skilled and unskilled) | Annual Report NIOH 1977 | Need for prompt ergonomic intervention was determined |
| Physical Stress in Oil Drilling | Oil drilling/ Northeast Brazil | Vertebral Disk disease | | Fernandes (2000) | Need for prompt ergonomic intervention was determined |
| Use of solvent-based chemicals; Leather dust | Home based shoe industry/informal sector/ Indonesia, Philippines, and Thailand | Nervous system effects, liver damage, reproductive effects; Risk of Nasal cancer;,respiratory diseases | Male, female and children | Markkanen 2004; | Footwear chemicals used are either inadequately labeled or not labeled at all. Information on ingredients used, hazards, and handling precautions are seldom provided. |

| Table 4. Association Between Internal Factors (Intermediate Variables) and Impact on Health | | | | | |
|---|---|---|---|---|---|
| **SDH Variable (Intermediate Variable)** | **Economic Sector/Country: informal/formal** | **Linkage to Health Outcome (incidence, exposure and pain reduction)** | **Socioeconomic Position (continued)** | **Evidence Base Citations** | **Comments** |
| Exposure to vapors from glues, skin contact with industrial adhesives, poor illumination, noise, poor ventilation and use of solvent-based chemicals; Leather dust | Footwear industry/small cottage and household industry/India | Respiratory problems, skin infections; Risk of Nasal cancer, | Child Labor | Tiwari (2005) | Children work for contractors at home. Major Export Industry |
| Occupational Health hazards faced by adults and children in carpet weaving | Carpet weaving industry/Informal Sector/Mirzapur India | Persistent cough, backache, common cold, joint pains | Child Labor (13.5%)and Adults | Das (1992) | |
| Occupational Hazards in Crop Production Activities | Agriculture | Traumatic Accidents and Injuries and Work Drudgery<br>Pesticide Poisoning | Male, Female, Children | Nag (2004)<br>Schenker (2002) | Option for Ergonomic Interventions and Reorganization of Work and Work Methods |

| | | | | | |
|---|---|---|---|---|---|
| Highly repetitive jobs involving continuous hand exertion, vibration and localized mechanical pressure. | Meat cutters, Typists, Tailors, Visual Display Terminal (VDT) Operators/informal Sector | Cumulative trauma disorder (CTD) | Male workers (skilled and unskilled) | Gangopadhyay (2000, 2003) | |
| Intensity of manual material handling –postures - repetition | Construction, health care, assembly line operations, clerical – CRT - use | Low back pain, injured joints, inflammation-musculoskeletal disorders (MSDs) | Male and Female workers (skilled and unskilled) | Lahiri, et al (2003)<br>Cohen, et al, 1994<br>Linton, 2001<br>NIOSH, 1997<br>OSHA Guide<br>OSHA's Federal Ergonomics Rule, 2000<br>ILO, 1996<br>National Research Council, 2001 | Wide-raging problem resulting in lost days, pain, chronic injury, and sometimes loss of ability to work. |

* These potentials are context specific and vary from country to country

| Table5. Analysis of Specific Interventions and Policies to Mitigate Health/ Health Inequity Impacts | | | | | | |
|---|---|---|---|---|---|---|
| **SDH Variable (Intermediate Variable)** | **Intervention/Policies** | **Study Design Cohort/Before and After/Experimental/Case Study** | **Effectiveness: Reduction of Incidence/ Exposure** | **Effectiveness: Health Inequity Reduction[1]** | **Evidence Base Citations** | **Comments** |
| High Stress in a Mexican Assembly Plant | Stress Prevention Program | Case Study | Increase rest periods and worker/supervisor communications; Decline of Absenteeism Psychosomatic Illness (-17%) | Targeted; Gap | Matrajt, M (1992) | Increased productivity by 1% in the study period |
| Sleep Disturbances and Errors in Italian Air Traffic Controllers | Improved Job Planning. Increase Rest Period and Rearrangement of Shifts Schedule | Case Study | Decrease in exposure duration by adding rest periods and shift rearranging; Decrease of job strain | Targeted; Gap; Gradient (spillover) | Costa, G. (1992) | Decrease of air misses |
| Stressful Working Condition for Coal Miners in India | Anti-Stress Program Training and Evaluation for Supervisors and Miners on Stress Coping Strategies; Increased Recreational Support System | Case Study | Increased Awareness of Stressors.; Increased Recreational Support System | Targeted; Gap | Sastry, G. (1992) | Reduction of Absenteeism |
| Stress Among Auto Manufacturers in U.S (Work Overload and Role Conflicts) | Formation of Stress and Wellness Committee (SWC). Surveys every 2 months | Case Study – Participatory Action Research (PAR) | Work Overload Role Conflict Addressed in SWC; Reduction of Stress | Targeted; Gap | Israel, B. et. al. (1992) | |

| Table5. Analysis of Specific Interventions and Policies to Mitigate Health/ Health Inequity Impacts | | | | | | |
|---|---|---|---|---|---|---|
| **SDH Variable (Intermediate Variable)** | **Intervention/Policies** | **Study Design Cohort/Before and After/Experimental/Case Study** | **Effectiveness: Reduction of Incidence/ Exposure** | **Effectiveness: Health Inequity Reduction[2]** | **Evidence Base Citations** | **Comments** |
| Worker Solvent Exposure (VOC) Metal/Wood Products | Cleaner Production Sustainability | Case Study-- Substitute Wax (Carnauba) for Solvents Mix (Xylene, Toluene, MIK, MEK, Acetone) | End Exposure to Solvents; Avoid CNS, Liver Effects to Workers | Targeted; Gap | Serra, W TURI Report #19 (1994) | Savings on electrical costs of Exhaust Ventilation |
| Dry cleaners exposed to Perchloroethylene (PERC) | Cleaner Production Sustainability | Case Study -- Substitute PERC for IPSO Wet cleaning system | End Exposure to PERC; Avoid Cancer risks , CNS and Liver effects | Targeted; Gap; Gradient (Spill over) | TURI Publication (1995) | Savings on Toxic disposal. IPSO costs less than PERC |
| Degreaser Operators Metal Aircraft Parts | Cleaner Production Sustainability | Case Study -- Substitute Organic Solvents for Water based solvents and Ultrasonics | End worker exposure to Methylene Chloride, 111TCE, CFC-113; Avoid Cancer Risk, CNS and Liver effects | Targeted; Gap | TURI Publication (1995) | Savings on Toxics disposal. Savings on Water usage |
| Reproductive Hazards of Pregnant Workers | Control Banding: Controls to Prevent or avoid Workplace Exposures | Case Series (80 Pregnant Workers). Control Recommendations based on qualitative Control Banding | Remove pregnant workers from exposures/ Other Control strategies; Avoid Exposure to Teratogenic substances. Protect Mothers | Targeted; Gap Gradient (Spill over) | Bracker, A et al (2005) | Avoid Expensive Problem Pregnancies and Birth defects |
| Exposure to Asbestos in Manufacturing and Construction | National ban in the mining, use, trade and recycling of Asbestos | Projection of exposures at the strictest levels (0.1 f/cc)still show excess of lung cancer of 5/1000 and mesothelioma | Reduction of exposure reduces risk. Elimination of exposure zero risk.; Construction workers/ families avoid asbestos caused diseases | Targeted; Gap Gradient | Landrigan (2005) | Healthier workforce more productive |

| Table 5. Analysis of Specific Interventions and Policies in the Internal Domain to Mitigate Impact on Health Opportunities and Health Inequity | | | | | | |
|---|---|---|---|---|---|---|
| **SDH Variable (Intermediate Variable)** | **Intervention/Policies** | **Study Design Cohort/Before and After/Experimental/Case Study** | **Effectiveness: Reduction of Incidence, Exposure, Pain** | **Effectiveness: Health Inequity Reduction** | **Evidence Based Citations** | **Comments** |
| Exposure to Benzene in Brazil Industry | Formation of Tripartite Group to decrease/eliminate Benzene use in Brazil | Government, Industry and Labor collaborative effort to decrease and eliminate benzene in 7 years period (1998-2005) | Reduction of exposure reduces risk. Elimination of exposure zero risk; Industrial workers avoid benzene caused diseases | Targeted; Gap | UN-ESA (2005) | Healthier workforce more productive |
| Silica Exposure | Wet Methods for cutting, grinding, chipping, sawing, jack hammering concrete | Case Study | 81-98% reduction in exposure | Targeted | Shields, 2000 Susi, 2001, NIOSH, 1998 | All values below OSHA PEL |
| Silica Exposure | Hydroblasting concrete or other silica-containing substrate - replacing sand blasting | Case Study | No exposure to silica dust | Targeted | 2000 Rosenberg in preparation | |
| Silica Exposure | Abrasive blasting a silica-free surface with sand alternative, steel shot | Case Study | 100% reduction in exposure | Targeted | Rosenberg In preparation Greskevitch, et al 2000[ii] | No exposure to silica dust |
| Silica Exposure | Local exhaust ventilation | Case Study | 98% reduction in exposure | Targeted | Susi, 2001 | Silica exposure below OSHA PEL |
| Intensity of manual material handling – postures - repetition | Personal Protective equipment –Back belts | Case Study | Minimal or no impact No significant incidence reduction | Not applicable | Alexander 1995 Wassell 2000 Mitchell 1994 Redell 1992 | Training or lack of it made no difference in outcomes. |

| Table 5. Analysis of Specific Interventions and Policies in the Internal Domain to Mitigate Impact on Health Opportunities and Health Inequity | | | | | | |
|---|---|---|---|---|---|---|
| **SDH Variable (Intermediate Variable)** | **Intervention/Policies** | **Study Design Cohort/Before and After/Experimental/Case Study** | **Effectiveness: Reduction of Incidence, Exposure, Pain** | **Effectiveness: Health Inequity Reduction** | **Evidence Based Citations** | **Comments** |
| Intensity of manual material handling – postures - repetition | Engineering Controls: Pneumatic wall lift; Nail gun extension handle; | Intervention research study of framing carpenters in residential construction | Significant reduction in biomechanical stress. 52% of participant workers reported less leg and back discomfort. | Targeted | Mirka, et al, 2003 | 28% increase in productivity |
| Intensity of manual material handling – postures - repetition | Engineering Controls: Overhead crane system | | 100% reduction in back pain injuries. | Targeted | *Modern Material Handling*, 1997 | Production workers in plastics factory. 24% experienced back pain injuries. Productivity increased 100% |
| Intensity of manual material handling – postures - repetition | Engineering Controls: Handles designed for carrying 1 and 5 gal plant containers to improve lifting; Commercial nursery | | 47% and 37% reduction in lifting indexes for 1 and 5 gal containers, respectively. 81% and 52% reduction in grip capability. | Targeted | Janowitz, et al 1995 | Workers reported a clear preference for new tools. |

| Table 5. Analysis of Specific Interventions and Policies in the Internal Domain to Mitigate Impact on Health Opportunities and Health Inequity | | | | | | |
|---|---|---|---|---|---|---|
| **SDH Variable (Intermediate Variable)** | **Intervention/Policies** | **Study Design Cohort/Before and After/Experimental/Case Study** | **Effectiveness: Reduction of Incidence, Exposure, Pain** | **Effectiveness: Health Inequity Reduction** | **Evidence Based Citations** | **Comments** |
| Awkward postures - repetition | Work station redesign | 1-year longitudinal study | 43% reduction in lower back pain severity; 82% reduction in lower back pain frequency | Targeted | Demure, 2000 | Workers involved in decision-making; Lower level workers physical health improved; |
| Intensity of manual material handling – postures - repetition | Training | Back injury control program in nursing home; Case-control study postal workers; Effectiveness of "Back School" for municipal workers | No significant differences | No significant change | Feldstein 1993; Daltroy 1997; Brown, 1992 | Little data on nature of training programs |
| Intensity of manual material handling – postures - repetition | Participatory ergonomics team | Case study of orderlies in an urban hospital | Total lost days per 100 employees per year declined from 64.3 to 7.1, an 88% reduction. | Targeted | Evanoff. 1990 | Workers compensation cost savings over a 2 year period estimated at $22,758. Improvement in health of lowest level hospital employees; |

| Table 5. Analysis of Specific Interventions and Policies in the Internal Domain to Mitigate Impact on Health Opportunities and Health Inequity | | | | | | |
|---|---|---|---|---|---|---|
| **SDH Variable (Intermediate Variable)** | **Intervention/Policies** | **Study Design Cohort/Before and After/Experimental/Case Study** | **Effectiveness: Reduction of Incidence, Exposure, Pain** | **Effectiveness: Health Inequity Reduction** | **Evidence Based Citations** | **Comments** |
| Dangerous, stressful working conditions | Participatory health and safety committee and worker inspectors | Multi-stakeholder project – international cos, contractors, workers, NGOs, Occ. Health professionals 4 factories in So. China | Problems identified, corrected; NGOs focus more time on occ. Health issues. | Targeted | O'Rourke 2003 Szudy 2003 | Workers able to identify hazards and stressful conditions. Top management commitment considered essential to success. |
| Exposure to dust containing free crystalline silica in the grinding process | Engineering Controls (Model Exhaust System for Grinding Machines) | Exposed subjects were compared to subjects in a controlled group/India | 93% dust and silica exposure control | Targeted | NIOSH Website Saiyed (2006)** Fingerhurt (2006) | High Power Consumption; Costs borne by employers and benefits to a large extent reaped by society; |
| Occupational Health hazards faced by adults and children in carpet weaving | Awareness camps, Installment of Plexiglas tiles for better illumination, training of community health volunteers and health education | Case study in the informal sector/India | Occupational Health as an entry point where child labor is involved proved to be successful | Targeted | (Das and Sukkla 1992) | Indo-Dutch project |

| Table 5. Analysis of Specific Interventions and Policies in the Internal Domain to Mitigate Impact on Health Opportunities and Health Inequity | | | | | | |
|---|---|---|---|---|---|---|
| **SDH Variable (Intermediate Variable)** | **Intervention/Policies** | **Study Design Cohort/Before and After/Experimental/Case Study** | **Effectiveness: Reduction of Incidence, Exposure, Pain** | **Effectiveness: Health Inequity Reduction** | **Evidence Based Citations** | **Comments** |
| High rates of HIV infection among sex workers | Multifacted, Multilevel interventions: High Status advocate; community empowerment project; | Case Study in the informal sector, Sonagachi, Calcutta/India | Lower HIV rates among sex workers as compared to other urban centers in India | Gradient | Jana (2004) | |

* These potentials are context specific and vary from country to country

**http://icmr.nic.in/000004/project1/project.htm