An overview of occupational health research in India

Abstract
Recent industrialization and globalizations are changing the Indian occupational morbidity drastically. Traditionally labor-oriented markets are on change towards more automation and mechanization, at the same time general awareness about occupational safety, occupational and environmental hazards were not spread in the society. This review will provide an overview of existing evidence from community based epidemiological studies and address the growing needs for evidence-based occupational health research in India. Review of all published results. Occupational research is seen as more complex issue in India, which includes child labor; poor industrial legislation; vast informal sector; less attention to industrial hygiene and poor surveillance data across the country. While India experiencing economic transition, occupational research approach should balance between understanding the modern industrial exposures and health risks of traditional sectors like agriculture and plantations. Strategies like modern occupational health legislation, enforcement machinery in sub-district level, training to health professionals, need for epidemiological evidence and international collaborations were discussed to deal with the situation.

Key Words: Occupational health, Environment, Work, Developing countries, Health

BACKGROUND
In India the traditional public health concerns likes communicable diseases, malnutrition, poor environmental sanitation and reproductive health care get emphasis and priorities in the health policy. Recent industrialization and globalizations changing the occupational morbidity drastically, the new pathologies like cancers, stress, AIDS, geriatrics, psychological disorders and heart diseases are on raise. With this new transition pose challenges to health care system with new concepts of environmental legislation, ethical issues, new safety regulations, insurance and high costs of healthcare.

Traditionally labor-oriented markets are on change towards more automation and mechanization, at the same time general awareness about occupational safety, occupational and environmental hazards were not spread in the society. With these structural changes the workers in low resource settings are more likely to be affected by the dangers of high technology than their counterparts in developed countries. Due to lack of education, unaware of the hazards of their occupations, general backwardness in sanitation, poor nutrition and climatic proneness of this geographic region to epidemics aggravate their health hazards from work environment.\(^1\)

In this country with local medievalism and multinational modernism exist side by side, the research on incidence, prevalence and prevention will have to address the needs in terms of future occupational health policy in India. The research approaches need to balance between understanding the modern industrial exposures and health risks of traditional sectors like agriculture and plantations. So far not much attention was drawn about the pool of agriculture workers and those working in several unorganized sectors. Being exposed to extreme whether conditions, sunrays, chemical and fertilizer poisons and mechanical hazards much attention is needed to reduce the accidents and diseases in these groups.\(^2\) Despite of proper evidence from epidemiological data or information systems, several pieces of information was available from small-scale and community based studies, which may be used for exploratory understanding of the occupation health situation in India.

EPIDEMIOLOGICAL EVIDENCE
Agriculture is the backbone of Indian economy where more than half of to-
tal workforce employed in agricultural sector. A study from south India presented us a picture of accidents in farming sector, most of the fatal accidents resulted from the powered machinery are mainly due to lack of skills to operate them, with an annual fatality rate estimated as 22 per 100,000 farmers. In spite of the enactment of legislation, the shortcomings in production and monitoring of the machinery in field use may be responsible for the high rate of accidents, 42 thresher accidents/4,000 mechanical threshers per year. Other study from Assam reveals that the afflicted paddy field workers develop exanthema on the exposed parts of their skin mainly legs and arms when they come in contact with water in rice fields and also highlights rice field dermatitis is an occupational health problem. A very high respiratory morbidity was recorded from a cross-sectional survey on mango plantation workers in Lucknow. This respiratory morbidity was attributed to prolonged inhalation of organic dusts during the farming operation. Despite the existence of law that prohibit a paid work from children under age 14 years, an estimated 70-115 million children are part of Indian work force. Child labor in the agriculture sector accounts for 80% of child laborers in India and 70% of working children globally. A study from three districts of west Bengal highlights occupational morbidity among agricultural child labour. The main health hazards reported to be heat-induced disorders, mechanical injuries, insect bites and toxic effects of chemicals. The children employed in carpet weaving in the Jaipur City provided an evidence of acute respiratory problems compare to normal children live in the same community (26.4% vs. 15.2%; P=0.005), which may be associated with cotton dust. Among the children working in the leather industry acute physical pains are reported as work related risks. These may be related with sitting posture of the child workers for long working hours and the chemical nature of the glue and solvents used in this industry. In Sivakasi, an estimated 125,000 children make up the child labor force, comprising 30% of the entire labor force. A part from deaths due to explosions and fire, Coughing, sore throat, dizziness, methemoglobinemia, and anemia are common effects of ingestion or inhalation of chlorate dust. Inhalation of sulfur dust causes respiratory infections, asthma, eye infections, and other chronic lung diseases. Among the occupational hazards, commercial sex work in India has been associated with higher HIV rates compared to other urban centers in the world. When the workers are children the risks are many folds. Recently some multilevel community interventions were initiated, addressing this community by preventing children to enter into this market, advocating, improving skill and competencies to prevent HIV, treatment and social relationships.

Participation of workforce in Industrial sector is on raise since independence in 1947. Occupational health studies in this sector initiated as early as seventies on tobacco workers, among those exposed to tobacco, an elevated level of nicotine was observed in the urine samples that was causing several physical problems. Among the tennery workers of Kanpur industrial slums, occupational morbidity was recorded as 28 per cent. The lock factory workers study in Aligarh showed that 73% of subjects under study are suffering with respiratory tract problems. Chronic bronchitis and emphysema are frequently diagnose and increasing with duration of work. Adult carpet weavers in Mirzapur also reported respiratory problems as major occupational risk, the causal factors are carpet dust particles. Regional occupation health center, which is a sister agency of Indian council for medical research (ICMR), conducted an epidemiological study in Bangalore on workers of incense sticks. The results highlight the possible inhalation of pollutants and related health hazards, this study also suggested a need for social workers, medical personnel and industrial hygienists to explore the possibilities of minimizing possible hazards. In a retrospective epidemiological study conducted on southeastern coal mine workers revealed the overall prevalence of pneumocnosis was about 3 percent in India. An increase in the deterioration of lung function was observed in Tamilnadu among the workers who are exposed to asbestos dust compared to the general workers in a manufacturing unit. Normally workers in the salt industry exposed to sunlight, salt dust and contact with brine. In a knowledge, attitude and practice study it was revealed that there is a huge gap between knowledge and practice of protective devises, despite of universal knowledge about the devises only one-third use them in practice.

More than 20 millions workers are involved in the textile industry which is a dye dominant industry in India. In 1995 with interventions of a non-governmental organization, byssinosis was first recorded in Indian history of 150 years textile industry. Out of 273 chest examines; 54 (30%) of the 179 individuals working in the dusty sections of a textile mill had byssinosis. In the non-dusty departments, 16 (17%) out of the 94 workers were affected. Similar study in Pondicherry reveals 6-fold risk of byssinosis among workers of spinning section and 2-fold increase among workers of weaving section.

There was a robust increase in Indian service and infrastructure sectors last two decades and now it constitute more than half of national income. Pooled analyses from five units of department of atomic energy seen clearly that the workers in the radiation units are not at extra risk of cancer compared to workers in non-radiation units. In another public sector industry, Indian Oil Corporation limited, prevalence of work related injuries are 35% among all injuries reported in their hospital and burn injuries were about 6% of all injuries. This study emphasizes causation of industrial burns and also dis-
cussed and importance of prevention of burns in industries. This clearly indicates that the safety measures are in place among organized and premier government and public sector institutes of India. In the similar line a study on heat exposure on glass works industry differs from international standards. It recommends separate standard measures for tropical and subtropical countries like India also suggest on ideal duration of work and duration of rest in the context of Indian glass industry.

Health care providers are at high risk of infection if they ignore safety measures, evidence from cohort study conducted on health care providers in andhra pradesh shown an association between occupation (hospital staff) and incidences of malaria. Due to lack of precautions, the risks are four-fold for nursing students and two-fold among medical students than well-trained doctors. Similar study on west bengal hospital personnel shown elevated risks of Hepatitis B infection. Another interesting study based on traffic policemen from six major town of north India attributed risk of exposure to benzene from fuel exhaust and also discussed how this inhaled benzene metabolised phenol, posing health consequences.

Research questions
There are very few professional agencies like National Institute of Occupational Health (NIOH), Industrial Toxicology Research Center (ITRC), Central Labour Institute are working on researchable issues like Asbestos and asbestos related diseases, Pesticide poisoning, Silica related diseases other than silicosis and Musculoskeletal disorders. Indian occupational health is more complex than a health issue, which includes child labor, poor industrial legislation; vast informal sector; less attention to industrial hygiene and poor surveillance data. Due to poor surveillance it is impossible to assess the disease burden in this country due to occupational exposure.

There is some sort of awareness or implementation of safety measures and legislation after the Bhopal gas tragedy in 1984. In this incident, poisonous gases leaked from a fertilizer factory killed 5800 and injured about half a million people. Their injuries ranged from breathlessness, gastrointestinal problems to neurological disorders. Most of the industrial laws in this country are only confide to the paper and never seen a reality in implementing their standards. There is always poor investment on industrial safety, labor is cheap and easily replaceable, so employers seen a need for improving occupational safety and health. Labor unions are mostly week, politician driven and lack knowledge about the occupational risks. Under the supervision of Inspector general of India, a small number of three hundred factory inspectors are responsible to check the industrial safety in this vast country, compared to 3000 factory inspectors in a small country like Japan. This shows the poor concern of the government about industrial safety and subsequently the occupational health.

On one hand there is need to understand the risk factors of modern occupations and on other hand the hazards from traditional occupations yet to explore. There is a big gap in the epidemiological evidence from different industry specific, exposure specific areas. Most of the studies mentioned above are very small-scale, community-based studies. They are often concluded from very small sample sizes between 200-300 subjects. The nature of various study-designs, control groups, interview procedures, self-reporting biases and statistical techniques used in those studies made the interpretations very complex, pose difficulties to generalize the conclusions about occupational risks.

Indian doctors and nurses are very poorly trained to deal with occupation health related morbidity. Neither many medical schools were specialized in this faculty nor offer specialized training. There is a big demand and supply equations for Industrial hygienists and occupational professionals and semi-professionals in the market. A silver line in this training aspect comes from the decision by Indian Medical association to educate all its members in occupational health issues.

Except few major, reputed, public and private industries, other industrialists are not sensitized about the importance of occupational safety in their industries. Occupational health never occupied proper place in their budgets. In some instances worker groups saw occupational safety equipment with negative attitude, and work without safety measures was seen as heroism among illiterate folks. Some of the other problems are from ill equipment, improper checks on fire fighting equipment, lack of training in use the safety equipment and alcoholism during work.

In last decade, there are some environmental activists trying to lobby the government towards ban of some hazardous materials. In the Asian continent, India is emerging as the major user of asbestos where the developed world phasing out its use. Due to poor occupational health and safety systems in India and difficulties in early detection of pulmonary malignancy related to asbestos, Indian government should consider the ban of this material in future. Recently, Indian Association of Occupation Health took a strong and principled stand against the asbestos industry and many of its members requested for the asbestos ban in India.

Occupational and environmental concerns are not two different issues. It is a big task to understand the intensity of environmental deterioration in this county. To mention few examples of environmental problems in India, as many as 42 million people in the West Bengal area of may be exposed to...
arsenic in drinking water at concentrations of health concern. Similarly, as many as 10 million industrial or mine workers in India may be exposed to asbestos or other dusts at concentrations of health concern.\[85\] Research questions should always need to integrate concerns of industrial safety, occupational health and environmental health together.

**NEED OF HOUR**

India urgently requires modern Occupational Health Safety (OHS) legislation with adequate enforcement machinery, and establishment of centers of excellence in occupational medicine, to catch up with the rest of the world.\[86\] To accelerate the process of providing OHS in organized sector, government may initiate local level organizations with industrialists, medical professionals, and researchers and trade unions as partners. Pilot studies are required to address some solutions in informal sectors.

Keeping the importance of primary sector in mind, skill training to agricultural units may reduce the accidents and related hazards. A block-level (sub-district), village levels agricultural workshops and training will help to save farmers from fatal hazards. The pesticides poisoning may be eliminated with help of latest development of chemical technology. The problem of transferring industries from industrialized world to India has a growing concern. Many of the hazardous industries were pushed from developed countries towards India due to their environmental regulations, increased labor costs and green moments. Due to poor implementation of industrial regulations, cheap labor, poverty and unemployment India welcome these hazardous industries.\[86\] Impose a strict vigilance on all those industries with hazardous materials. Government should also weigh between environment and health costs of our people and cost of importing them from elsewhere.

All health professionals, para-medics and industrial hygienists were thoroughly trained about occupational health safety and exposure to hazardous material at all levels of hierarchy in the health sector (referral hospitals, primary and urban health centers). Interventions need to be introduced about the awareness of health hazards among public, workers, and trade unions. This effort should also promote universal acceptance of protection material. Many community-based interventions are on-going in India (TB, HIV prevention, immunization etc.), a comprehensive approaches to including occupational health will be cost-effective method to achieve this Himalayan task.

There is a tremendous potentiality for large-scale epidemiological research to determine the exposure and occupational risks. The public-private partnerships are very important to success of this goal. Most difficult part of occupational health research is exposure assessment by recording life time job history, job titles, and information on past occupations, industries, and occupational conditions, and identification of other causal confounders. Listing all occupational carcinogens were identified and listed by International Agency for Research on Cancer (IARC/WHO), which provides data on carcinogenicity of chemicals, groups of chemicals, industrial process and other complex mixtures.\[87\] Most of the evidences in these monographs are from developed world; since there is no such studies in India replicate some of the exposure studies in India to test the validity of the similar carcinogenicity.

To assess the occupational situation, data from other sources may be streamlined. Record occupation on various data bases of public use (ration cards, driving license etc.), surveillance of disease occurrence in industrial belts, analyzing occupation on death certificates, using record-linkage techniques between various resources may also improve the research potentiality on occupational health. To start with, some geographical (ecological) correlation studies will helps to generate hypothesis about occupational risks in various parts of India. However, large-scale retrospective cohort studies will address many of the policy questions in this country. Various sophisticated expert assessment tools are needed to validate the occupational exposures and their risk.\[88\] Collaborations with international occupational experts will be a quick solution to address these technical difficulties.

Initially we need more focus on epidemiological data for decision making and setting priorities in the research, pioneering institutes like NIOH and ITRC should be updated with advanced research facilities in epidemiological research. Meanwhile we also need to generate a pool of human resources in occupational health researchers, creation of environmental and occupational health cells at all district levels may help us to develop some databases or information systems across the country. All international treaties and agreements should also address the concerns of occupational health as mandatory.

Some international collaboration are in action for some time for Indo-Dutch Environmental and Sanitary Engineering Project under the Ganga action plan work working for social health and community improvements in the Industrial slums.\[84\] Several collaborations are on going in technology of industrial safety. India also signed a bilateral collaborative agreement with United States in terms of emergency preparedness and response; training, education, and technology transfer; and research.\[89\] To meet local shortage of resources, to address all outstanding issues in the fields of environmental and occupational health, India should turn towards international community and World Health Organization (WHO).
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