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Respiratory and general health impairments of workers employed in a municipal solid waste disposal at an open landfill site in Delhi

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Abstract

The objective of this study was to examine the respiratory and general health of workers employed in a municipal solid waste (MSW) disposal at an open landfill site in India. Ninety-six landfill workers of Okhla landfill site, Delhi, and 90 controls matched for age, sex, and socioeconomic conditions were enrolled. Health data was obtained from questionnaire surveys, clinical examination and laboratory investigations. Lung function was evaluated by spirometry.

Compared with matched controls, landfill workers had significantly higher prevalences of both upper and lower respiratory symptoms, and they suffered more often from diarrhea, fungal infection and ulceration of the skin, burning sensation in the extremities, tingling or numbness, transient loss of memory, and depression. Spirometry revealed impairment of lung function in 62% of the landfill workers compared to 27% of the controls. Sputum cytology showed squamous metaplasia, abundance of inflammatory cells, alveolar macrophages (AM) and siderophages (macrophages with iron deposits), and high elastase enzyme activity in neutrophils and AM of a majority of landfill workers, indicating adverse cellular lung reaction. Hematological profiles of these workers depicted low hemoglobin and erythrocyte levels with high total leukocyte, eosinophil and monocyte counts. Erythrocytes with target cell morphology were abundant in 42% of the landfill workers compared to 10% of the controls. Toxic granulation in neutrophils, an indication of infection and inflammation, was recorded in 94% of the landfill workers and in 49% of the controls. The results demonstrated higher prevalence of respiratory symptoms, inflammation of the airways, lung function decrement and a wide range of general health problems in MSW disposal workers.

Keywords: Lung function; General health; Landfill workers; Delhi

Introduction

Uncontrolled land filling practices and associated problems of municipal solid waste (MSW) disposal is a growing environmental and public health concern in the developing world. In India, about 50 million tons of MSW is collected by the civic authorities every year, 90% of which is dumped in low-lying areas at the

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outskirts of the cities (TERI, 1998). Landfill sites of the country receive all kinds of garbage like food wastes, dead animals, plastics, rubber, chemical wastes, etc. In addition, health-care wastes including used needles and syringes are often dumped in landfill sites in contradiction to the Government's rules requiring separate disposal of biomedical wastes (Patil and Shekdar, 2001). The wastes are dumped and spread in an uncontrolled and uncovered manner causing great public nuisance.

The landfill sites often lack provisions for leachate collection and treatment, and landfill gas collection and use. As a consequence, the landfill gases escape into the atmosphere adding to green house gas emissions. Thus the land filling practices are considered unsafe for human health and the environment (Al-Yaquot and Hamoda, 2002). Installation of appropriate systems for urban waste disposal in the developing countries is delayed for several reasons like non-availability of appropriate technologies, absence of professional training, and inadequacy of funds (Patil and Shekdar, 2001). An important factor in the Indian context, however, is the lack of basic epidemiological data on the health impact of prevailing waste management practices that would motivate and drive the authorities to adopt safer management techniques. Indeed, little attention has been focused so far on the health impact of chronic exposure to MSW in India. Against this background, we have investigated in this study the respiratory and general health of MSW disposal workers at Okhla landfill site, Delhi.

Materials and methods

Study area

The landfill site at Okhla in southeast Delhi, covering an area of 32.6 ha, receives an average of 1500 tonnes of MSW per day. The waste basically consists of household garbage, street sweeping and demolition wastes. In addition, a fair amount of biomedical waste is dumped here. The average depth of the waste in the landfill area was 45 ft. Total suspended particulate matter (TSP) in the site varied between 559 and 2082 $\mu g/m^3$, which was much higher than the local standards for MSW dumping sites (500 $\mu g/m^3$), but levels of sulfur dioxide and oxides of nitrogen were within standards. There was no arrangement for segregation of wastes in the landfill site. A large number of ragpickers scavenge the landfill area to salvage recyclable materials like paper, plastic, and glass. Unrestricted flow of cattle, abundance of flea (*Mucosa domestica*) and offensive odor at the landfill coupled with the lack of proper protective devices make the conditions even more unhygienic for the workers.

Subjects and working conditions

Ninety-six individuals (all males, age 25–57 years, median 37 years) employed in this landfill site were enrolled in our study. Among them, 47 were waste loaders and drivers of waste transport trucks, eight were garbage-weighing staff, 25 were waste spreaders, and 16 were supervisory staff. They worked 8 h per day, 6 days a week. They did not use protective masks and gloves at the landfill, thereby exposing themselves to a wide range of pathogens, helminth eggs and sharp materials like broken glass or used needles. The control group consisted of 90 adult males from east Delhi who were mostly construction workers with similar age, socio-economic conditions and literacy (Table 1). The landfill workers and controls were selected randomly. However, persons with known history of asthma, cardiac problems or under medication for any ailments were excluded from this study. The work was done simultaneously in control and landfill groups to eliminate the confounding effect of seasonal variation on health response. The Ethics Committee of Chittaranjan National Cancer Institute approved the study protocol.

Collection of respiratory and general health data

The subjects were interviewed and asked to fill in a questionnaire giving information about family, socio-economic conditions, habits, type and duration of work, upper and lower respiratory symptoms (LRS), gastro-intestinal, ophthalmic, neurological and neurobehavioral problems experienced in the 3 months prior to the interview. Since many landfill workers and controls were poorly educated, the investigators on their behalf filled in the questionnaires. A registered medical practitioner clinically examined the subjects. Signs and symptoms presented by an individual at least once in the last week and twice in the previous 3 months were recorded. Respiratory symptoms were ascertained from questionnaire responses and broadly grouped into two (Pope III and Dockery, 1999): upper respiratory symptoms (URS) like sinusitis, running or stuffy nose, sore throat, common cold and fever, and LRS like dry cough, cough with phlegm, wheezing and chest discomfort.

Pulmonary function test by spirometry

Lung function test was performed in a sitting position with the nose closed by nose-clips using a portable, electronic spirometer (Spirovit SP-1 Schiller, Switzerland) following American Thoracic Society guidelines (ATS, 1995). Spirometers were calibrated daily before the test using a 2.0 l-syringe. Each subject performed at least three tests and the results were accepted if the two largest forced vital capacity (FVC) and forced