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# Serum total immunoglobin-E and health hazards in workers involved in land fill and compost areas of hazardous waste management plants

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## Abstract

### Background:

The exposures of bio-aerosols have reported higher occupational health hazards, the association between serum total IgE levels and job categories and occupational health hazards of waste disposal area was limited. The present study was undertaken to assess the relationship between occupational health hazards and Serum total IgE in waste disposal area.

### Materials and Methods:

One hundred eighty subjects working in waste disposal areas in different parts of Bangalore at Karnataka, India were enrolled into the study in 2009. Using questionnaire the respiratory morbidity and other work related problems in HWW was carried. The levels of serum total IgE in study subjects were determined by using Enzyme–linked –immunosorbent assay kits (DRG International Inc, USA). The differences of serum total IgE levels between the groups were computed by using non-parametric Mann-Whitney U test. SPSS 10.0 for windows version of statistical software was used in the analysis.

### Results:

The levels of serum total IgE was significantly increased in landfill area ($P$=0.027) compose plant workers ($P$=0.020). The morbidity conditions such as respiratory and musculoskeletal found significantly higher in waste disposal workers as compared to controls.

### Conclusion:

The levels of serum total IgE was significantly increased in land fill area and compose plant workers but no significant relationship was found between the levels of serum total IgE and occurrence of health related symptoms or past respiratory disease.

**Keywords:** Morbidity, serum total IgE, waste disposal sites

## INTRODUCTION

Hazardous Waste (HW) is generated from main sources viz. industrial and household. This waste is disposed by different methods i.e. recycling, composting, waste treatment, incineration and landfill (waste disposal on land). The job process of waste disposal areas involves i.e. waste collectors, waste sorters and workers at landfill.[1] In India the amount of HW generated is of the order of 7.243 million tons per annum (TPA) and out of this 1.4 million tons are recycled, 0.4 million tons are incinerated and the rest is disposed by landfill. There are 454 waste generating units in Bangalore at Karnataka, India

which generated 1.023 million tons per annum and out of the 0.47 million tons are recycled, 0.33 million tons incinerated and the rest is disposed by landfill. The processes of waste disposal areas are covered under section of 6, 8 and 25 of environment (protection) act of hazardous waste management 1989. According to a report published during 2000 by the Ministry of Environment and Forests, Govt. of India, much of the HW disposal is done by landfill.[2]

The composition of waste stream at Columbia landfill in Missouri have reported 41% paper, 21% organic, 16% plastic, 6% metal, 3% glass and 13% other waste.[3] The handling and disposal of waste cause environmental pollution, which create breeding grounds for pathogenic organisms and spreading of infectious diseases.[4] Occupational health hazards associated with waste disposal area are infections to the skin, blood, eyes and intestines.[5] The workers involved in waste disposal areas have reported higher level of respiratory, dermatological and musculo-skeletal effects.[6–12] Other health hazards reported as increased chromosomal aberrations[13] occurrence of stillbirths and congenital malformations in general population residing near the landfill.[14] The waste disposal areas (collection and disposal) have reported higher levels of respirable dust, bioaerosols like endotoxins, (1→3) -β -D-glucan, viable fungi and it spores and fungal extra-cellular polysaccharides.[15–19] A significant association was noticed between airways inflammation and microbial components of endotoxin and (1→3) -β -D-glucan in waste disposal areas.[20–22] The occurrence of occupational respiratory symptoms was resulted from airways inflammation which is caused due to exposure of toxins, pro-inflammatory and allergens. The airways inflammatory mediatory mechanism involves in two types viz, allergic and non-allergic respiratory symptoms.[23] The allergic respiratory symptoms reflect immune specific inflammation in which antibodies like IgE and IgG plays major role. The higher levels of serum total IgE were reported in art conservators and museum workers exposed to fungi,[24] tetrachloroethylene exposure from dry cleaning process,[25] strawberry green house workers,[26] laboratory animal workers[27] chlorohexadine used by health care workers[28] wheat flour exposed workers from bakery industry[29] grain storage godowns workers.[30]

No reports are available in the literature regarding the relationship between occupational health hazards and serum total IgE among workers involved in waste disposal area. The present study was undertaken to evaluate the relationship between occupational health hazards and serum total IgE among workers involved in hazardous waste disposal area.

## MATERIALS AND METHODS

The survey was performed in 180 study subjects working in hazardous waste areas of Bangalore at Karnataka, India during the year 2009. These subjects were categorized into three groups. The first group consisted of 60 subjects occupied in landfill disposal area, the second group consisted of 60 subjects engaged in compost process and the third group consisted of 60 office workers with no exposure of biological hazards from waste disposal area as control group. Ethical committee of center approved the study. Informed consent was obtained from each of study participants.

### Medical examination

The study subjects were interviewed with the American Thoracic Society (ATS) Standard questionnaire for respiratory symptoms. The other work related symptoms were collected through a questionnaire developed by Ray *et al*.[7]

### Blood collection

2 ml of whole blood was collected from each subject in test tubes and centrifuged at 3000 rpm for 10 min at 4°C and serum was separated used for the determination of immunoglobin –E concentration.

### Serum total Immunoglobin-E

The concentrations of serum total immunoglobin-E were measured in workers involved in hazardous waste management area by using with enzyme-linked immunosorbent assay (ELISA) kits (DRG International Inc, USA). The absorbance of standards and samples were measured by using Thermo Scientific Multiskan EX–reader (USA) at 450nm. Taking the mean of the duplicate readings and

subtracting the absorbance of the average zero standards measured the absorbance of each standards and samples. Plot the standard curve with standard concentration on the X-axis and absorbance on the Y-axis. The concentration of each sample was calculated by using standard curve. The levels of serum total immunoglobin-E expressed as IU/ml.

### Statistical Analysis

The levels of serum total immunoglobin-E were expressed as geometric mean (GM). The proportion of morbidity conditions among waste disposal workers and controls were compared by using F-test. The differences of serum total immunoglobin-E between groups were computed by using non-parametric Mann Whitney-U test. *P*-value < 0.05 was considered as significant. SPSS 10.0 for windows version of statistical software was used in the analysis.

## RESULTS

The demographic details of mean age, experience, body mass index (BMI) and frequency distribution of life style confounding factors (smoking, alcohol consumption and chewing of tobacco products) of study subjects is shown in Table 1.

The morbidity conditions of solid waste workers occupied in landfill area, compost and administrative sections were reported in Figure 1. The respiratory complaints were significantly increased in land fill area (*P*=0.006) and compose plant workers (*P*=0.0006) as compared to controls. The musculoskeletal complaints were significantly increased in compose plant workers (*P*=0.0008) as compared to controls. The other health hazards were not shown any significant difference among waste disposal workers when compared to controls.

The geometric mean levels of serum total immunoglobin-E in subjects according to job category are presented in Figure 2 The levels of serum total IgE level was significantly increased in landfill area workers (*P*=0.027) compose plant workers (*P*=0.020) as compared to controls. The levels of serum total IgE was increased by 28.3% in landfill area workers and 30.8% in compose plant workers as compared to controls. Highest increase was noticed in compose plant workers as compared to land fill area workers.

The levels of serum total immunoglobin-E in subjects according to occurrence of morbidly conditions in hazardous waste management area are reported in Table 2. The serum total IgE levels were increased in the subjects having health related symptoms as compared to no symptoms. The results of study found no significant relationship was found between the levels of serum total IgE and occurrence of health related symptoms or past respiratory disease.

## DISCUSSION

The present study assessed the relationship between occupational health hazards and serum total immunoglobin-E in workers engaged in hazardous waste area. The occupational health hazards reported as respiratory followed by musculo-skeletal, dermatological, gastrointestinal, injuries and nose and eye problems. The highest occupational health complaint was found as respiratory system. Bunger *et al*,[31] reported 24% respiratory, 13.8% skin and 7% of gastrointestinal complaints in hazardous waste workers (HWW) who had 3 years of mean duration of exposure. The present study has reported higher health complaints in HWW because they had 5 years of mean duration of exposure. Vrijheld *et al*,[32] have reported health complaints such as headaches, sleepiness, respiratory, psychological, gastrointestinal, cancers, adverse pregnancy outcomes, abnormalities in liver and renal function of workers exposed from landfill area. Goorah *et al*,[33] have reported respiratory symptoms such as bronchitis 26.1%, COPD 15.1% and asthma 13%, 26.9% of skin irritation, 19.9% nasal irritation, 22.9% eye irritation and gastrointestinal problems (5.25% diarrhea, 11.1% constipation, 10.3% abdominal pain, 14.9% vomiting and nausea) in landfill area workers from Mare chicose in Mauritius with 30 years of exposure. Most of the studies indicated that the workers involved in these hazardous waste industries are exposed to high levels of microorganisms' causes higher prevalence of respiratory symptoms and airways inflammation. [22,33] The present study also indicated higher level of respiratory symptoms as compared to other health hazards.

The waste disposal areas (collection and disposal) have reported higher levels of respirable dust, microbial component like endotoxins, (1→3) -β -D-glucan, viable fungi and its spores and fungal extra-cellular polysaccharides.[15–19] Higher respiratory symptoms and airways inflammation are associated with higher levels of neutrophil counts and production of pro-inflammatory cytokines.[24]

Coenen *et al*,[34] have reported significant association between high endotoxin exposure (72 EU/$m^3$) and serum concentration of IgG in waste collectors. Wouters *et al*,[22] have reported 27% increased levels of serum total IgE in waste collectors involved in municipal waste collecting facility at Dutch cities. Marth *et al*,[35] also reported higher levels of serum total IgE in employs engaged in waste sorting facility. In the present study we undertaken to find out the relationship between occurrence of health hazards and serum total IgE in workers involved in waste disposal sites. We found that the levels of serum total IgE were significantly increased in land fill area and compose plant workers as compared to controls. Skorska *et al*,[36] have reported significantly increased levels of serum total IgE in workers occupationally exposed to organic dust from hatchery process and found non- significant relationship between the levels of serum total IgE and occurrence of health related symptoms or past respiratory disease. In the present we also found increased levels of serum total IgE in land fill area and compose plant workers and no significant relationship was found between the levels of serum total IgE and occurrence of health related symptoms or past respiratory disease.

## CONCLUSION

The levels of serum total in land fill area and compose plant workers but no significant relationship was found between the levels of serum total IgE and occurrence of health related symptoms or past respiratory disease.

## Footnotes

**Source of Support:** Nil

**Conflict of Interest:** None declared.

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## Figures and Tables

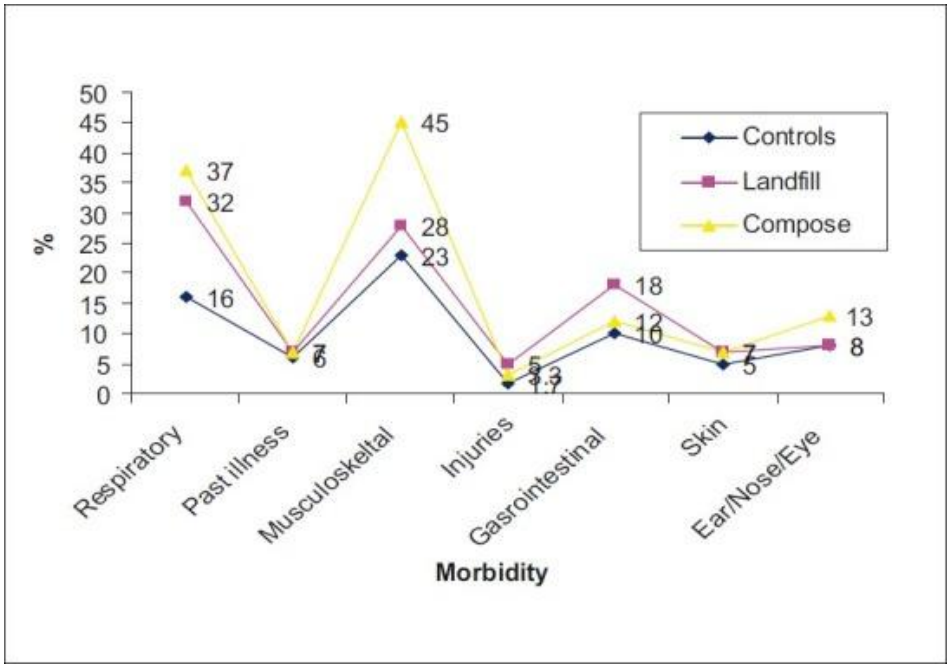
Table 1

| Variables | Controls (60) | Landfill (n=60) | Compost (n=60) |
|---|---|---|---|
| Age (yr)[A] | 30 ± 10 | 29 ± 12 | 33 ± 11 |
| Experience (yr)[A] | 5.2 ± 2.3 | 5 .0 ± 3.0 | 5.0 ± 4.0 |
| Body mass index (kg/m$^2$)[A] | 21.8 ± 3.5 | 22.2 ± 3.5 | 21.1 ± 3.1 |
| Smoking history[B] | | | |
| Smokers | 22 (37) | 25 (42) | 15 (25) |
| Non- smokers | 38 (63) | 35 (58) | 45 (75) |
| Alcohol consumption[B] | | | |
| Regular | 02 (03) | 02 (03.3) | 07 (11.7) |
| Occasional | 27 (35) | 29 (48.3) | 16 (26.7) |
| Never | 31 (52) | 29 (48.3) | 37 (62.7) |
| Chewing of tobacco[B] | | | |
| Yes | 11 (18) | 22 (37) | 26 (43) |
| No | 49 (82) | 38 (63) | 34 (57) |

[A]: Mean and standard deviation, [B]: Number and percentage of smokers

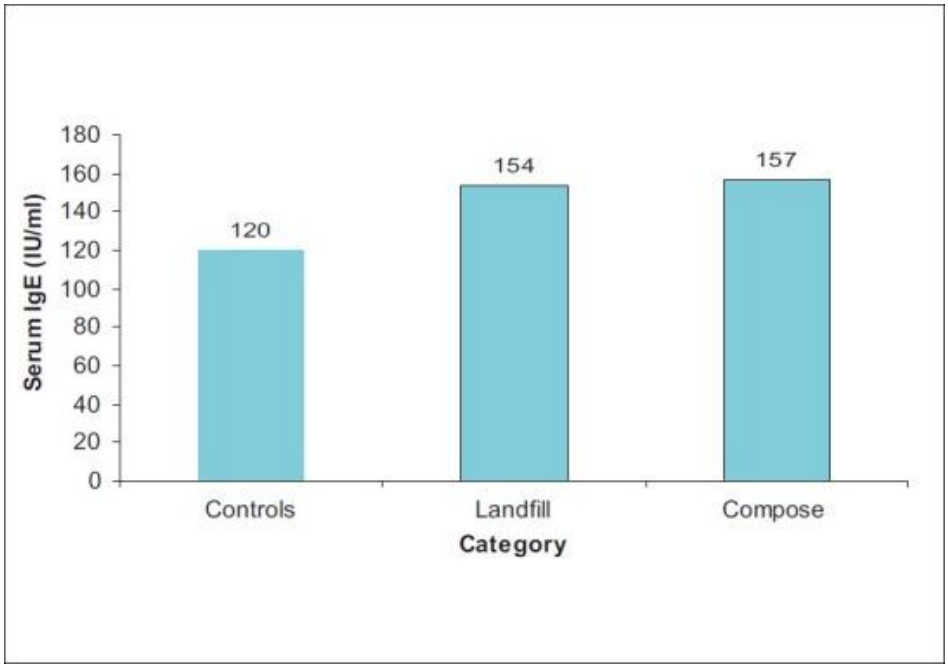
Demographic detail of waste disposal area workers

Figure 1




Shows the morbidity pattern of landfill, compose plant workers and controls

Figure 2




Shows the geometric mean levels of Serum total IgE in different category of workers

Table 2

| Complaints | N 180 | % | Serum total IgE (IU/ml) | *P* Value |
|---|---|---|---|---|
| Respiratory | | | | |
| Yes | 54 | 30 | 150 | 0.403 |
| No | 126 | 70 | 140 | |
| Musculoskeletal | | | | |
| Yes | 58 | 32 | 153 | 0.335 |
| No | 122 | 68 | 138 | |
| Past illness | | | | |
| Yes | 12 | 07 | 175 | 0.142 |
| No | 168 | 93 | 141 | |
| Gastrointestinal | | | | |
| Yes | 24 | 13 | 137 | 0.101 |
| No | 156 | 87 | 144 | |
| Skin problem | | | | |
| Yes | 11 | 06 | 165 | 0.405 |
| No | 169 | 94 | 141 | |
| Ear/Nose/eye | | | | |
| Yes | 18 | 10 | 163 | 0.163 |
| No | 162 | 90 | 141 | |

Geometric mean levels of serum total IgE in subjects according to morbidity

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