Reduction in respiratory symptoms among cement workers: a follow-up study

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Background
Several studies have reported associations between cement dust exposure and adverse respiratory health effects, but there are few follow-up studies and no studies of respiratory health effects following dust control measures.

Aims
To assess changes in respiratory health among cement workers and unexposed controls after 1 year in a factory implementing a health and safety campaign with the main aim to increase use of personal protective equipment. Earlier the factory had made technical improvements which had reduced dust levels.

Methods
Respiratory questionnaire interviews and personal total dust exposure assessments were conducted in 2010 and 2011.

Results
A total of 171 cement workers and 98 controls participated in the study in 2010. The prevalence of cough, cough with sputum, dyspnoea and wheeze among the 134 exposed workers assessed at follow-up in 2011 was significantly lower than in 2010, but not among 63 controls followed up in 2011. Total dust exposure levels among exposed workers did not differ between 2010 and 2011.

Conclusions
The prevalence of respiratory symptoms among cement workers was reduced after 1 year of follow-up following an intervention campaign to improve use of personal protective equipment.

Key words
Dust exposure; cement; respiratory symptoms.

Introduction
Several studies report associations between cement dust exposure and adverse health effects in the respiratory system [1–5]. There are no follow-up studies on respiratory health effects following improvement of dust control measures in cement factories. Major technical improvements were made between 2002 and 2010 to reduce dust exposure levels in the Tanzanian cement plant studied [6], followed by minor improvements between 2010 and 2011 (Figure 1). In addition, a health and safety campaign that involved training and provision of respiratory protective equipment (RPE) for cement plant workers was introduced in 2010 (Figure 1). This 1-year follow-up study reports changes in respiratory symptoms among cement production workers.

Methods
The study was conducted among Tanzanian cement production workers (exposed) and among mineral water factory production workers (controls) between 2010 and 2011. All study participants were males. Data on personal total dust exposure and respiratory symptoms were collected between June and August in 2010 and again in 2011. The personal dust samples were collected on cellulose acetate filters placed in 37-mm Millipore cassettes outside any protective equipment...
and analysed at the Eurofins laboratory in Denmark (Eurofins Products Testing, Denmark). Ethical clearance was obtained from the Regional Ethics Committee for Medical and Health Research Western Norway and the Muhimbili University of Health and Allied Sciences Research and Ethics Committee. Each participating worker gave written informed consent in both 2010 and 2011. Interviews on respiratory symptoms were performed using a modified British Medical Research Council (BMRC) questionnaire [7]. Participants were considered to have respiratory symptoms if they answered ‘yes’ to at least one of the questions in a symptom category (cough with or without sputum, dyspnoea, work-related shortness of breath and wheeze). The prevalence of each symptom category was defined as the proportion of participants having at least one of the respiratory symptoms in each main symptom category. A two-sample t-test was used to compare log-transformed total dust exposure levels between 2010 and 2011. Wilcoxon signed-ranks test was used to determine differences in the prevalence of respiratory symptoms between 2010 and 2011.

Results

In 2010, the cement plant had 495 workers, with 411 in the production section. Of these, 210 production workers were randomly selected and invited to participate in the baseline study. The control plant had 679 workers, with 349 workers in the production section, and 105 randomly selected production workers were invited to participate in the baseline study. Personnel list and day shift lists were used for daily selection of five to six participants among cement plant workers and controls in both 2010 and 2011. A total of 171 out of 210 invited cement plant workers (81%) and 98 out of 105 controls (93%) participated in follow-up. The proportions of workers lost to follow-up among exposed and controls were 22 and 35%, respectively. Exposed workers and controls had similar baseline characteristics, except height. Workers lost to follow-up did not differ in baseline characteristics from those followed up in 2011 (Table 1). The prevalence of all respiratory symptoms was elevated in cement plant workers in 2010 compared with controls, although the proportions were not significantly different (Table 1). The prevalence of all respiratory symptoms (except for work-related shortness of breath) in cement plant workers was significantly lower in 2011 than in 2010, but not in controls (Table 1). The overall total dust exposure among cement workers did not differ significantly between 2010 and 2011 [geometric mean (GM) = 5.0 mg/m³; range: 0.6–69; N = 126 and GM = 7.4 mg/m³; range: 0.3–110; N = 52, respectively]. In controls, the GM for total dust exposure in 2010 and 2011 were 0.60 mg/m³ (range: 0.40–1.10; N = 16) and 0.39 mg/m³ (0.05–1.80; N = 28), respectively.

Discussion

Our study found a lower prevalence of respiratory symptoms at 1-year follow-up compared with baseline among cement plant workers, but not among controls.

The study is strengthened by its follow-up design, high response rates and objective measurement of personal dust exposure levels. Potential confounders such as age, history of previous chest illnesses and smoking were taken into account. Limitations of the study include its short follow-up period, lack of pre-employment or baseline health examinations and also a possible selection bias due to the healthy worker effect. Possible explanations for the reduction in respiratory symptoms among cement workers may include an increase in knowledge and improved acceptance of personal protection as a result of the

Figure 1. A timeline indicating workplace improvements in a Tanzanian cement factory.
Table 1. Participants’ characteristics, prevalence of respiratory symptoms among workers exposed to cement and controls at baseline (2010) and at follow-up (2011)

<table>
<thead>
<tr>
<th></th>
<th>Followed up workers</th>
<th>Lost to follow-up</th>
<th>Followed up versus lost workers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Exposed</td>
<td>Controls</td>
<td>Exposed</td>
</tr>
<tr>
<td>Age, years</td>
<td>N = 134</td>
<td>N = 63</td>
<td>N = 134</td>
</tr>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>Employment years</td>
<td>35 (9.0)</td>
<td>33 (7.2)</td>
<td>NS</td>
</tr>
<tr>
<td>Height, metres</td>
<td>1.7 (0.1)</td>
<td>1.69 (0.1)</td>
<td>***</td>
</tr>
<tr>
<td>Primary education only</td>
<td>73 (55)</td>
<td>38 (60)</td>
<td>NS</td>
</tr>
<tr>
<td>Ever-smokers</td>
<td>37 (27)</td>
<td>18 (29)</td>
<td>NS</td>
</tr>
<tr>
<td>Current smokers</td>
<td>24 (18)</td>
<td>12 (19)</td>
<td>NS</td>
</tr>
<tr>
<td>Respiratory symptoms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cough</td>
<td>28 (21)</td>
<td>10 (16)</td>
<td>NS</td>
</tr>
<tr>
<td>Cough with sputum</td>
<td>26 (19)</td>
<td>8 (13)</td>
<td>NS</td>
</tr>
<tr>
<td>Dyspnoea</td>
<td>19 (14)</td>
<td>6 (10)</td>
<td>NS</td>
</tr>
<tr>
<td>Work-related shortness of breath</td>
<td>22 (16)</td>
<td>5 (8)</td>
<td>NS</td>
</tr>
<tr>
<td>Wheeze</td>
<td>24 (18)</td>
<td>12 (19)</td>
<td>NS</td>
</tr>
</tbody>
</table>

N, total number in a group; n (%), number (percentage); NS, not significant.
<sup>a</sup>Independent t-test between exposed workers and controls, and between followed up and dropouts.
<sup>b</sup>Chi-square test between exposed workers and controls, and between followed up and dropouts.
<sup>c</sup>Wilcoxon signed-ranks test.
P<sub>a</sub>, significance level; *P < 0.05, **P < 0.01, ***P < 0.001.

In conclusion, respiratory symptoms among cement plant workers were significantly reduced after 1 year of follow-up in a factory which had promoted RPE use and implemented dust control measures, although measured dust exposures did not change.

**Key points**
- Reduction in respiratory symptoms after 1 year of follow-up was seen in this population of African cement dust-exposed workers.
- Symptom reduction after promotion of respiratory protective equipment use and reinforced control of dust in a cement factory indicates that such measures can produce measurable improvements in workers’ health, at least in the short term.
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Conflicts of interest
None declared.

References