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# Effect of exposure to cement dust on lung function of workers at Atbara Cement Factory

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## ملخص البحث

المقدمة: ارتبط التعرض لغبار الاسمنت بوجود اعراض امراض الجهاز التنفسي ونقصان في عمل الرئة وايضا قد تسبب في امراض الجلد و سرطان الحنجرة والرئة واورام في الجهاز الهضمي.  
الاهداف: تناولت هذه الدراسة اثر التعرض لغبار الاسمنت على وظائف الرئة للعاملين في مصنع عطبرة للاسمنت.  
طرق البحث: تم فحص وظائف الرئة لدي اربعين عاملا بالمصنع لا تقل مدة عملهم عن ثلاث سنوات و اربعين متطوعا لم يتعرضوا لغبار الاسمنت. تم ملائمة المتطوعين والعمال من حيث العمر والطول والجنس. يتراوح عمر المشاركين ما بين 20-50 عام. جميع المشاركين من غير المدخنين وليس لهم تاريخ مرضي لامراض القلب والصدر.  
تم قياس السعة الحياتية القصوي والحجم الزفيري الاقصى في الثانية الاولى عن طريق جهاز مقياس وظائف الرئة وتم ايضا قياس اقصى معدل للزفير عن طريق جهاز "رايتس" لقياس المعدل الزفيري القصوي.  
النتائج: اظهر البحث احصائيا نقص في السعة الحياتية القصوي والحجم الزفيري الاقصى في الثانية الاولى واقصى معدل زفير لدي العاملين الذين تعرضوا لغبار الاسمنت عند مقارنتهم بالمتطوعين. كما لوحظ ايضا نقصان في نسبة الحجم الزفيري الاقصى في الثانية الاولى / على السعة الحياتية. لكن ذلك النقص لم يصل الي مستوي الاثبات الاحصائي. هذا الاثر السلبي على وظائف الرئة يزداد كلما طالت مدة عمل العامل بالمصنع.  
الخلاصة: التعرض لغبار الاسمنت قد يؤدي الي امراض انسدادية وتليفية في الرئة ويجب عمل دراسة مستقبلية تضم عددا كبيرا من العمال ليتمكن دراسة هذه الامراض.

## Abstract

**Background:** Exposure to Portland cement dust has long been associated with the prevalence of respiratory symptoms and varying degree of reduction in lung function. It also causes dermatitis, lung and laryngeal cancer and gastrointestinal tumors.

**Objectives:** This study assessed the effect of exposure to cement dust on lung function in factory workers at Atbara cement factory by measuring Forced Vital Capacity (FVC), Forced Expiratory Volume in the first second (FEV<sub>1</sub>), FEV<sub>1</sub>/FVC ratio and Peak Expiratory Flow Rate (PEFR).

**Methods:** Forty workers employed for at least 3 years and forty controls (non exposed) were selected. The two groups were matched in terms of age, height and sex. The age of the subjects ranged between 20-50 years. Both groups were non smokers, had no cardiopulmonary diseases or symptoms during the time of study. Spirometer and Wrights Peak Flow Meter were used for measuring lung functions.

**Results:** Statistically, significant reduction in FVC, FEV<sub>1</sub> and PEFR were found in exposed workers when compared to control. The FEV<sub>1</sub>/FVC ratio, although was less in exposed workers, the difference was found to be insignificant. Lung function indices were found to be reduced with increasing duration of exposure to cement dust.

**Conclusion:** Reduction in FVC, FEV<sub>1</sub>, PEFR implies that exposure to Portland cement dust may result in restrictive and obstructive pulmonary diseases. The insignificant difference in FEV<sub>1</sub>/FVC ratio may indicate that there is less element of obstructive pulmonary disease. Further studies with large sample sizes are needed to evaluate the effect of exposure to Portland cement dust on Sudanese workers.

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## Introduction

The cement industry in Sudan has been known since 1930 when a small factory was established to provide cement to Sinnar Dam Project. This was followed by setting up of Atbara Cement Factory in the North in 1947<sup>(1)</sup>.

Exposure to Portland cement dust has long been associated with the prevalence of respiratory symptoms<sup>(2,3)</sup> and varying degrees of airway obstruction and reduction in lung function<sup>(4)</sup>. It was also found to be the cause of lung and laryngeal cancer<sup>(5)</sup>, gastrointestinal tumors<sup>(6)</sup> and dermatitis<sup>(7)</sup>. It has even been incriminated in increasing preterm delivery among pregnant women living around cement plants<sup>(8)</sup>. This study was conducted to evaluate the effect of exposure to cement dust on lung functions in factory workers at Atbara cement factory.

## Material and methods

Forty male workers in the cement factory were randomly selected. The selection criteria were an age between 20-50 years and duration of work in the cement factory not less than three years. The exclusion criteria were smoking and history of pulmonary or cardiac disease. Forty non-smoking control subjects were included in the study that were matched for age and sex.

A questionnaire was designed to include data about age, height, weight of the subject and the duration of work

in the cement factory. The questionnaire also included information about any respiratory symptoms. A clinical examination was performed and then pulmonary function tests were done. The peak expiratory flow rate (PEFR) was measured with a Wright Peak Flow Meter. Forced Vital Capacity (FVC), Forced Expiratory Volume in the First Second (FEV<sub>1</sub>) were measured by using a digital Spirometer. The data was analyzed using unpaired student t-test with SPSS package.

## Results

The FVC of the workers exposed to cement ranged between 2.00 - 3.8L with a mean of  $2.82 \pm 0.23$  (Table 1). The FVC of the control subject ranged from 3.00 - 4.70 with a mean of  $3.45 \pm 0.31$  (Table 1) when compared to that of exposed workers a significant difference was obtained ( $P < 0.05$ ). The FEV<sub>1</sub>, for workers exposed to cement ranged between 1.60 - 3.00L with a mean of  $2.4 \pm 0.3L$  (Table 1). The FEV of the control subjects ranged between 2.1 - 4.0L with a mean of  $3.1 \pm 0.2$  (Table 1). The FEV<sub>1</sub> was significantly reduced when compared to control subjects. The mean value of the ratio of FEV<sub>1</sub>/FVC in exposed workers was  $87.4 \pm 9.2$  while that of control subject was  $90.6 \pm 4.4$  (Table 1). There was no statistical difference between these two means.

Table 1. The mean  $\pm$  SD of FVC, FEV<sub>1</sub>, FEV<sub>1</sub>/FVC and PEFR in workers exposed to cement dust and control subjects

Variable	Control subjects	Exposed subjects
FVC	$3.45 \pm 0.31$	$2.82 \pm 0.23^*$
FEV <sub>1</sub>	$3.10 \pm 0.26$	$2.48 \pm 0.33^*$
FEV <sub>1</sub> /FVC	$90.67 \pm 4.46$	$87.48 \pm 9.22$
PEFR	$473.25 \pm 51.56$	$376.00 \pm 20.10^*$

- Statistically significant

The mean value of peak expiratory flow rate in exposed workers was  $376.0 \pm 20.1L/min$  while that of control subjects was  $473.25 \pm 5.1$  (Table IV). The PEFR was significantly reduced in exposed workers. A significant negative correlation was obtained when the FVC, FEV<sub>1</sub> and PEFR were compared to the duration of work in cement factory workers (Figures I, II, III).

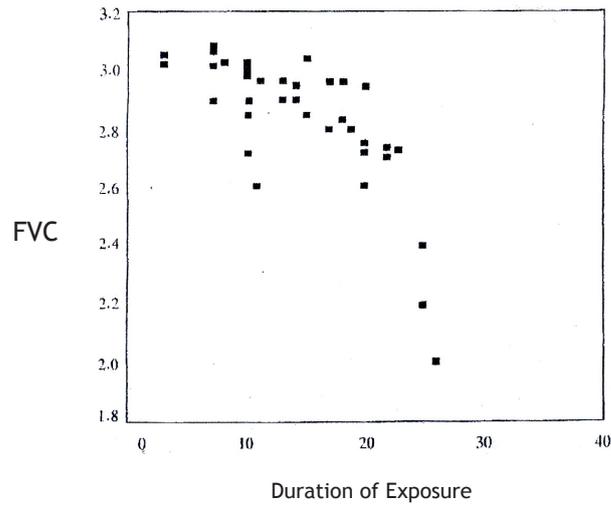


Figure I. Effect of duration of exposure to cement dust on Forced Vital Capacity (FVC): P is significant ( $P=0.00$ )

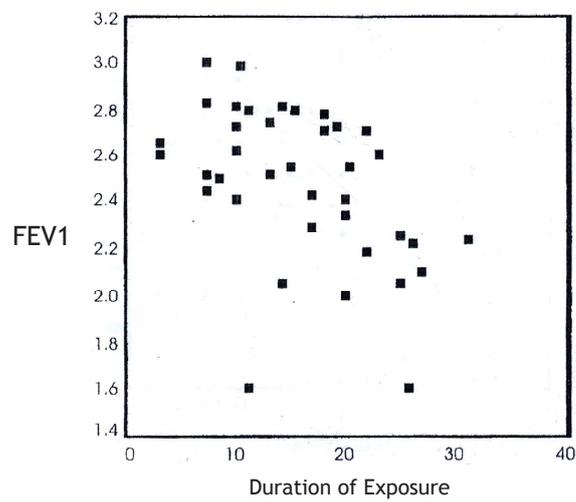


Figure II. Effect of duration of exposure to cement dust on Forced Expiratory Volume in the first second (FEV1): P is significant ( $P=0.00$ )

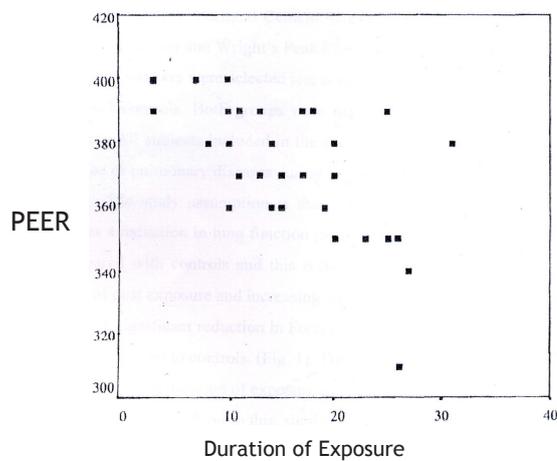


Figure III. Effect of duration of exposure to cement dust on Peak Expiratory Flow Rate (PEFR): P is significant ( $P=0.00$ )

## Discussion

This study evaluated lung functions (FVC, FEV1, PEFR and FEV1/FVC ratio) in Portland cement workers at Atbara Cement Factory using Spirometer and Wrights Peak Flow Meter.

A significant reduction in Forced Vital Capacity (FVC), Forced Expiratory Volume in the first second (FEV1) and Peak Expiratory Flow Rate (PEFR) was found when compared to controls (Table I).

Similar findings were also observed in cement workers in different countries. Which included Nigeria<sup>(9)</sup>, United Arab Emirates<sup>(10)</sup>, Morocco<sup>(11)</sup>, Saudi Arabia<sup>(12)</sup> and Tanzania<sup>(13)</sup>. Meo et al<sup>(14)</sup> had reported that not only lung functions were reduced in cement factory workers but also the intercostal muscles performance as indicated by reduced surface electromyography.

The reduction in lung functions (FVC, FEV1, PEFR) was increased proportionally with the duration of exposure to cement dust.

Although FEV1/FVC ratio was less in exposed workers than controls, the difference was found to be statistically insignificant. In contrast Ali et al<sup>(12)</sup>, Yang et al<sup>(2)</sup>, Al Neaimi et al<sup>(15)</sup> reported significant reduction in FEV1/FVC ratio in exposed workers when compared to controls. The reduction in FVC, FEV and PEFR were significantly correlated to increasing duration of exposure to cement dust. This was also documented by Milavdovic et al<sup>(16)</sup> who reported that the reduction in lung function was correlated to the duration of exposure to cement dust. Reduction in FVC, FEV1 and PEFR implies that exposure to Portland cement dust may result in restrictive pulmonary diseases. The statistically insignificant difference in FEV1/FVC ratio may indicate that there is less obstructive pulmonary diseases. A further study with a large sample size is needed to confirm the occupational health hazards caused by exposure to Portland cement dust in Atbara, Sudan. Good control of dust and usage of effective preventive measures with proper supervision are important to minimize the effect of exposure to dust in Portland cement factories.

In a study in Norwegian cement workers<sup>(17)</sup>, no significant reduction in lung function was reported. This might be due to more vigilant occupational protection measures used by these workers.

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