

The Effect of Silica on Cement Factory Workers A Clinico-Radiologic Study

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Abstract:

Objective; To study the prevalence of silicosis among the workers in Al Falluja cement factory.

Subjects; Two hundred and forty two workers had been surveyed for prevalence of silicosis.

Methods; The workers were asked for the presence of cough, phlegm, breathlessness, wheezing and also examined for the presence of clubbing, rhonchi, loss of weight and other related signs. Radiological finding were classified according to ILO / UC international classification of radiographs of pneumoconiosis.

The diagnosis of silicosis among these workers was based entirely on the existence of nodular opacities in chest radiograph.

Results; Approximately one third (36.4 percent) of the workers were found to be suffering from various grades of silicosis. It was observed that with the increasing duration of work, silicosis became more frequent. Complicated silicosis was very rare in this study.

Respiratory symptoms generally did not help in the diagnosis of silicosis.

Conclusions; The high incidence of silicosis among these workers is attributed to the high dust concentration in the immediate environment of these workers in addition to the lack of effective preventive measures.

Introduction:

Silicosis is a fibrotic disease of the lung caused by inhalation of dust containing crystalline silicon dioxide. It is reported as the most prevalent chronic occupational disease of the world despite the fact it is a markedly underestimated disease.⁽¹⁾

As most of the earth's crust consist of compound of silicon , people in many occupations are at risk of developing silicosis.

The diagnosis of silicosis depends upon a history of appropriate exposure and confirmed by consistent radiographic and physiologic abnormalities.⁽²⁾

Subjects and Methods:

242 laborers from Al Falluja white cement factory (it is the only factory in Iraq that produce white cement) were included in this study. Specific questionnaires was prepared for each worker including place and nature of work, duration of exposure, protective equipment (mask), smoking habit, respiratory symptoms, level of dust concentration was roughly measured according to place of work and divided in to low, moderate and high level.

Investigation of Simple tests includes hemoglobin level, white blood count and differential count, ESR.

Each Cement worker was chest X rayed with large postero- anterior film and compared with the standard ILO films (International classification of radiographs of

pneumoconiosis 1980; International Labors Office, Geneva).

For easy correlation we divide the chest X-ray films into grades 0 to 2 as follows: grade 0 , normal; grade 1, small opacities (rounded or irregular) of < 1 cm in diameter of different extent and profusion, these indicate simple (uncomplicated) silicosis; Grade 2, large opacities > 1 cm size or combination of large and small opacities indicate complicated silicosis (progressive massive fibrosis PMF).

Hilar lymphadenopathy, egg shell calcification and pleural plaques were classified according to associated paranchymal opacities⁽³⁻⁴⁻⁵⁾.

Increased lung markings and reticular opacities were ignored.

Results:

A positive radiological evidence of silicosis was available in 88 cases (36.4 %). As shown in Table 1.

There is no minimum time interval for silicosis as it observed in 32.5 % of < 5 years work duration , although the risk of

silicosis was steadily increased with increasing duration of work . (Table 2)

In the positive group of 88 cases , most of the cases had simple silicosis (Table 3). There is no relation between the severity of silicosis and duration of work, also 50 % of silicotic cases had more than 10 years of exposure to dust.

In more than half of workers (62.3 %) there were no symptoms at all, there is no significant difference in symptoms between silicotic and non silicotic groups. When the results were analysed for silicotic and non-silicotic groups (Table 4).

Table 5. Shows high prevalence rate of silicosis for workers who exposed to a low level of dust concentration (29.8%).

The prevalence of silicosis in non smoker was (37%) while 45% of heavy smoker had silicosis (Table 6).

Table 7 shows only 92 (38 %) of workers were receiving preventive equipments which were masks. 36 (41%) of those who were assumed to wear masks developed silicosis, in comparison with 52 (59%) who had no preventive measures who developed silicosis.

Table 1. Age distribution of workers and prevalence of silicosis

<i>Age in years</i>	22-30	31-40	41-50	51->60	Total
No. of workers					
with silicosis	18	32	28	10	88
Without silicosis	46	52	32	24	154
Total	64	84	60	34	242
Prevalence of silicosis (percent)	28.1	38	46.6	29.4	36.4

Six females had silicosis (54.5 percent).

Table 2. Prevalence of silicosis in relation to duration of work

Period of service	< 5 years	5-10 years	>10years	Total
Total cases	80	62	100	242
Positive group	26	18	44	88
Negative group	54	44	56	154
Prevalence rate (percent) of silicosis	32.5	29	44	36.4

* Chi seq. = 4.68 significant $p < 0.05$

Table 3. Severity of silicosis in relation to Period of service++

Duration of employment	< 5 years	5-10 years	>10years	Total
Simple silicosis	21	15	41	77
Complicated silicosis	5(*)	3	3	11
Total	26 (29.5%)	18 (20.5%)	44 (50%)	88

++9 cases associated with hilar calcified lymphadenopathy, 2 cases with pleural plaques.

* One case associated with cavitation. chi seq. = 1.51 not significant $P > 0.05$

Table 4. incidence of various symptoms in negative and positive silicotic groups

*

Total cases examined	No symptoms	With symptoms	Cough \pm sputum	Dyspnea	Wheezing	Clubbing of fingers
Negative group 147	93 (63.2%)	54 (36.7%)	40 (27.2%)	15 (10.2%)	7 (4.7%)	—
Positive group 79	48 (60.7%)	31 (39.2%)	28 (35.4%)	13 (16.4%)	7 (8.8%)	2++
Total 226	141 (62.3%)	85 (37.6%)	68 (30%)	28 (12.3%)	14 (6.2%)	

*Fourteen cases with bronchiectasis (five in negative and nine in positive group) + two cases of heart failure in negative group have been excluded from this analysis.

++ One of them had PMF (complicated silicosis).

Chi seq. = 0.14 not significant $P > 0.05$

Table 5. Prevalence of silicosis in relation to level of dust exposure*.

Level of dust exposure	Low level	Moderate level	High level	Total
Total cases	104	35	103	242
Positive group	31	15	42	88
Negative group	73	20	61	154
Prevalence rate (percent)	29.8	42.8	40.7	36.3

* Dust concentration was not measured in this study, roughly estimation according to place of work.

Chi seq. = 3.4 not significant $P > 0.05$

Table 6. Prevalence of silicosis in relation to smoking.

Smoking category	Non smokers	<10cig/day	10-20 cig/day	>20 cig/day	Total
Total cases	184	58			242
		18	20	20	
Positive	68	20			88
		6	5	9	
Negative	116	38			154
		12	15	11	
Prevalence rate	37%	33.3%	25%	45%	

Chi seq. = 1.64 not significant $P > 0.05$

Table 7. Prevalence of silicosis in relation to preventive measures

Preventive equipment (mask)	No preventive equipment	With preventive equipment	Total
Positive group	52 (59.1%)	36 (40.9%)	88
Negative group	98 (63.6%)	56 (36.4%)	154
Total	150 (62%)	92 (38%)	242

Chi seq. = 0.49 not significant $P > 0.05$

Discussion:

A diagnosis of silicosis rests primarily on a positive history of sufficient exposure to dust hazard coupled with radiographic demonstration of certain **characteristic** appearance. one third (36.4 percent) of workers were found to be having silicosis. This result coincides with Gupta et al, prowse et al who reported 35.2 percent and 37.5 percent.^(3,4)

Prevalence of silicosis among those workers was found to be increased with increasing duration of work, although 32.5 percent of workers developed silicosis in the first 5 years of work.

Jain et al found that short period of two years of exposure was enough to give rise to discernible silicosis in about 25 percent of the cases⁽⁶⁾, while other investigators specified 10 years of exposure for this⁽³⁾.

Our observation is due to the fact that these workers were involved in a heavy dust concentration in addition to the lack of any effective control measures.

The clinical features did not reveal any significant difference between the silicotic and non silicotic groups, this was reported by other workers (Parker and Wagner, Gupta et al .)^(1,3),

symptoms alone can not serve as a basis for diagnosis of silicosis in these cases as the presentation may be an asymptomatic with an abnormal chest radiograph.

Symptoms were also found in patients with normal x-ray films (36.7 percent) this is due to the fact that dust produces bronchial irritations.

Terrence et al found the difference in symptoms based on exposure to dust was small and not significant after adjustment for smoking history⁽⁷⁾.

Although dust concentration was not measured in this study, a high prevalence rate of silicosis for workers in a place assumed to have a low dust concentration indicates an extremely dusty environment with lack of effective protective measures as was observed. Rough division of dust concentration according to place of work pointed to a non significant difference in developing silicosis in a moderate and a high level exposure groups.

The relative effect of cigarette smoking may be underestimated because individuals who develop respiratory symptoms or who are aware that they have silicosis may be more likely to stop smoking than others as it is well known that tobacco smoking was found to potentiate the effect of dust on respiratory impairment⁽⁸⁾. It is possible that cigarette smoking and exposure to silica interacts with each others to produce an effect that could not be assessed in this analysis.

In spite of the dusty environment and lack of any dust control measures except simple and usually non protective masks which were always leaky and were not weared by most of the workers either because it is too hot to wear respiratory masks

or because of ignorance, the simple respiratory masks show no significant role in protection.

Conclusions:

The high prevalence rate of silicosis among cement workers can be explained by the following factors:

- a. A very high content of silica in the additive material for cement production (sand 92.2% , flint 45.14%).
- b. Although dust concentration was not measured in this study but occupation was observed to be dusty, high concentration of dust arising in the vicinity of the workers, this may be due to leaky mechanic valves as spare parts were not always available.
- c. The lack of any effective respiratory protection program.

The prevalence of silicosis among these workers was found to be increased with increasing duration of work, it should be emphasized here that as a short duration of work was enough to give rise to discernible silicosis in about one third of the cases.

More advanced form of disease does not appear to be related to long duration of work, this indicates that heavy exposure to silica dust rather than duration plays a role in developing complicated type of silicosis.

The clinical features did not reveal any significant difference between the silicotic and non silicotic groups, so symptoms alone couldn't serve as a basis for diagnosis of silicosis in these cases, while symptoms appear to be related to increasing duration of work however, in view of the fact that cases with long duration of work were also more aged and were smokers for long period, this correlation may be more approximate than real.

In this study, mask does not appear to play any role in prevention of silicosis because it is either not used or leaky.

Recommendations:

- 1- Radiological examination of the chest (using large films) is important to be done at least annually (with careful review of previous chest radiographs) to detect the changes due to silicosis.
- 2- Occupational health education of workers is necessary for attracting their attention toward the hazard of silica dust exposure and measures to control exposure is also important.
- 3- Those workers who had radiological changes for silicosis should be moved away from dust as the probability of progression is likely to be reduced.
- 4- As tobacco smoking was found to potentiate the effect of silica dust on respiratory impairments, encouragement for stopping is important.
- 5- Measurement of silica particles is important to ascertain the safe limit for dust exposure. (WHO recommended not more than 40 :gm of free silica /m³).
- 6- There is a need to expand the study to include the surrounding residential villages.

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