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Correlation Between Smoking and Lung Abnormalities

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Abstract

Background: Both dust inhalation and smoking combined, led to more deleterious effect on the lungs. The health of gold miners is not only eroded by excessive exposure to dust in the mines, but also by the habit of smoking. Smokers have a significantly higher risk of getting lung cancer than non-smokers.

Objective: The objective of this study is to establish the relationship between smoking and lung abnormalities among ex-mineworkers in the Transkei region of South Africa.

Patients and Methods: During a two years period (May 1997 to May 1999) 2080 former mineworkers were examined at the Benefit Examination Clinic at Umtata General Hospital, a tertiary hospital attached to the Walter Sisulu University in Eastern Cape Province. Radiological examinations were carried out on (466) former mineworkers, in the age group ranging from 30 years to 70-plus years.

Results: Mineworkers who had smoked exhibited two to three times the number of gross lung abnormalities on radiological examination than those who had had no experience of smoking in their life. The readings taken indicated an odd ratio (OR) of 2.0 with a p value of <0.05, and Chi-square 8.3, indicative of statistically significant association between smoking and lung abnormality in the ex-mineworkers (i.e. ex-smokers, smokers, and non smokers).

Conclusion: There is a strong correlation between lung abnormalities and smoking among ex-mineworkers in this study.

Keywords: Smoking; Lung abnormality; Ex-mineworkers; Dust; Lung cancer.

Introduction

The global trend in tobacco related deaths is very high, according to a 1999 World Bank report. With current smoking patterns, 500 million people alive today will eventually be killed by tobacco use. More than half of these are now children and teenagers. By 2030 tobacco use is expected to be the single biggest cause of death worldwide.[3] Smoking-related deaths are projected to rise to 10 million a year by the 2020s, with 70% of these mortalities assumed to occur in poorer countries.[4] Lung diseases are ranked the third major killer in America, responsible for one in seven deaths. Today, more than 30 million Americans are living with chronic lung diseases such as asthma, emphysema and chronic bronchitis.[5] Lung cancer, one of the few malignancies of which the main cause is definitely known and that can be prevented, is on the increase especially in developing countries that have been targeted by tobacco companies.[6] The mining industry has also underestimated the crippling effects of tobacco smoking among its employees. The two commonly used legal drugs, alcohol and tobacco, are more frequently consumed among miners than all illegal drugs combined.[7]

No estimate of tobacco smoking in South Africa is available, but it seems to be a more serious and widespread problem than is readily acknowledged, especially among ex-mineworkers of Transkei. These mineworkers have also been exposed to silica

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dust, which, together with tobacco smoking that is a common practice among the black mineworkers, has a devastating effect on their health. The complex of dust inhalation with smoking in the causation of lung diseases is certainly health degenerating, as a large number of ex-mineworkers have experienced when they developed lung abnormalities.

Patients and Method

During a five years period from May 1997 to May 2002, about 3000 ex-mineworkers were examined at the Benefit Examination Clinic, a clinic located at Nelson Mandela Academic Hospital (NMAH) a tertiary hospital attached to the Walter Sisulu University in the Eastern Cape Province. The benefit examination of ex-mineworkers is done once a week. The ex-mineworkers present themselves on this day for a comprehensive checkup to enable them to claim compensation from their former employers. A record of their history of mining and ID documentation, a chest X-ray and a report of a physical examination are then documented and forwarded to the Medical Bureau of Occupational Diseases in Johannesburg to process the compensation claims.

This study was a descriptive one, carried out by random sampling of data collected from X-ray photographs taken from X-ray plates of the chests of 466 ex-mineworkers. These photographs were interpreted by an independent radiologist. The interpretations of the photographs by the radiologist were then compiled with smoking, non-smoking and ex-smoking histories in relation to lung abnormalities. The word "abnormalities" is defined in Longman's English dictionary as being different from what is expected, usual or average, especially in a bad or undesirable way. It has been used instead of disease throughout this study. Photographs of X-ray plates of ex-mineworkers were studied in an attempt to ascertain unusual states, different from normal ones, exhibiting gross morphological changes.

This examination sought to establish the presence of opacities in the lung fields, gross tracheal deviations, and structural abnormalities of the lungs and pleurae. In the majority of cases a mixed picture was observed and this was taken into account in the final diagnoses, with the help of an independent radiologist.

This method in fact leads to underestimation of lung pathologies, as many of the smaller opacities are not obviously visible on the X-ray photographs. Since it is a comparative study of lung abnormalities in three categories of mineworkers, i.e. non smokers, smokers and ex-smokers, gross errors in judgment are neutralized. All the data were collected and analyzed by Epi6 Info computer program. The result was displayed in figures and tables.

Results

Three-fifths (63%) of the ex-mineworkers presented signs of lung abnormality, as shown in Table VI. This was found mainly in 39% of the middle-aged (40-59 years) group. In contrast, no lung abnormality was detected in 174 (37%) of the ex-mineworkers sampled.

Table VI: Different age groups with lung abnormality detected in ex-mineworkers of the Transkei.

Age groups	Lung abnormality detected	No lung abnormality detected	Total
30 to 39	23 (5%)	33 (7%)	56 (12%)
40 to 49	84 (18%)	57 (12%)	141 (30%)
50 to 59	97 (21%)	40 (9%)	137 (30%)
60 to 69	68 (15%)	29 (6%)	97 (21%)
70 +	20 (4%)	15 (3%)	35 (7%)
Total	292 (63%)	174 (37%)	466 (100%)

Chi square 18.36 P value 0.001 (Statistically highly significant).

Non smokers showed lung abnormalities in about half (50%) of the photographs examined, as shown in Table III. The other half (50%) of non smokers did not present any detectable abnormality (Fig. 5).

Table III: Lung abnormality detected in non-smokers in age groups among ex-mineworkers of Transkei.

Age groups (years)	Gross lung abnormality detected	No lung abnormality Detected	Total
30 to 39	4 (4%)	11 (11%)	15 (15%)
40 to 49	11 (11%)	13 (14%)	24 (25%)
50 to 59	13 (14%)	10 (10%)	23 (24%)
60 to 69	13 (14%)	9 (9%)	22 (23%)
70+	7 (7%)	6 (6%)	13 (13%)
	48 (50%)	49 (50%)	97 (100%)

Chi square = 4.62, p value = 0.32 (Statistically not significant)

Three-fourths (75%) of the smokers group showed lung abnormality, as shown in Table IV. This was found predominantly (46%) in the middle-aged (40-59 years) group. In contrast, no lung abnormality was detected in one-fourth (25%) of ex-mineworkers who had been smoking.

Table IV: Lung abnormality detected in smokers in different age groups of ex-mineworkers in the Transkei.

Age Groups	Lung Abnormality Detected	No Abnormality Detected	Total
30 to 39	12 (8%)	7 (5%)	19 (13%)
40 to 49	33 (23%)	15 (10%)	48 (33%)
50 to 59	33 (23%)	8 (5%)	41(28%)
60 to 69	24 (17%)	5 (4%)	29 (21%)
70 +	5 (4%)	1 (1%)	6 (5%)
Total	107 (75%)	36 (25%)	143 (100%)

Chi square = 4.21, p value= 0.378 (Not significant).

Three-fifths (61%) of the ex-smokers among the ex-mineworkers showed lung abnormality, as shown in Table V. This was again found predominantly (41%) in the middle aged (40-59 years) group. In contrast, no lung abnormality was detected in two-fifths (39%) of ex-smokers.

Table V: Lung abnormality detected in ex-smokers in different age groups among ex-mineworkers in the Transkei.

Age Groups	Lung Abnormality Detected	No lung Abnormality Detected	Total
30 to 39	7 (3%)	15 (6%)	22 (9%)
40 to 49	40 (18%)	29 (13%)	69 (31%)
50 to 59	51 (23%)	22 (10%)	73 (33%)
60 to 69	31 (14%)	15 (7%)	46 (21%)
70+	8 (3%)	8 (3%)	16 (6%)
Total	137 (61%)	89 (39%)	226 (100%)

Chi square= 12.10, p value=0.016 (Statistically significant)

Discussion

This study is a first of its kind and aims to estimate the deleterious effects of smoking among ex-mineworkers of Transkei. The mortality and morbidity rate as a result of tobacco smoking among ex-mineworkers is difficult to estimate, but there are a number of indicators suggesting that the incidence of lung diseases is very high, and therefore mortality is probably high as well. This high incidence of lung diseases could be explained by the inhalation of pollutants, either mining dust or tobacco smoke or both.

Isolating the effects of these two types of pollutants on the lungs is not an easy task. However, it is clear from the radiological interpretations of X-rays that smokers presented more and also more complicated lung abnormalities than non-smokers, quantitatively as well as qualitatively. The proportion of dust and tobacco smoke inhalation could be creating a complex, which rapidly leads to pulmonary fibrosis, faster than when dust or smoke alone is inhaled. Tobacco smoke of course independently contributes to disability by causing chronic bronchitis and chronic airflow obstruction.[8]

More than three-fifths (63%) of the sampled ex-mineworkers showed lung abnormality, as shown in Table VI. This was found mainly (39%) in the middle aged (40-59 years) groups. In contrast, no lung abnormality was detected in 174 (37%) ex-miners. This high percentage of lung abnormalities could be associated with exposure to unlimited amounts of pollutants in the dusty environment, as well as smoking. The high prevalence of infectious diseases such as tuberculosis, with or without silicosis (71.2%), proved that abundant lung abnormality occurs among the ex-mineworkers.[1] The excessive mortality due to chronic respiratory diseases is not surprising. Both cigarette smoking and exposure to dust in mines are causal factors of chronic respiratory diseases.[9,10]

Fifty percent of the non smoking subjects showed lung abnormalities, though the other half presented no evidence of gross lung pathology, a ratio of 1:1; among smokers 75% showed abnormal pictures and the other 25% showed no abnormalities (ratio of 3:1); while in ex-smokers 61% indicated gross abnormalities of the lungs and 39% showed no abnormality (ratio of 3:2). This indicates that non smokers are much healthier than smokers and ex-smokers. It also indicates that ex-smokers are healthier than smokers. We can easily conclude that quitting smoking is advantageous. Again, the lung abnormalities detected in the study samples were observed predominantly in the 40-59 middle aged groups. Forty-six percent of smokers, 41% of ex-smokers, and 25% of non smokers showed abnormal lung pictures on the X-ray photographs' interpretations, as shown in Tables III-V.

In a normal individual, after the age of 25, lung function as measured by FEV1 normally declines steadily at a rate of 25-30 ml per year. In a smoker the rate approaches 60 ml per year and the FEV1 'nosedives'. This degree of deterioration could be steeper in ex-mineworkers, as they had also been exposed to dust inhalation in addition to smoking. On stopping smoking, although lost lung function is not recovered, the rate of decline slows to normal. Even when the smoker is disabled by chronic obstructive pulmonary disease (COPD), the rapid decline of FEV1 is slowed to normal by smoking cessation, and a worthwhile gain in quantity and quality of life is achieved. Therefore, it is never too late to stop smoking.[11]

COPD progresses very gradually and

breathlessness only becomes troublesome when about half of the lung has been destroyed. The disease is rarely reversible once it established. Smoking is now the main cause of COPD. It is very rare in non-smokers and at least 90% of deaths from this disease can be attributed to cigarette smoking.[12] By far the greatest risk factor for COPD is cigarette smoking. The mixture of smoking and dust exposure probably enhances the effects in the lung in the causation of COPD. In the experience of the author, COPD in women smokers is hardly ever as bad as among mineworkers. This is probably due to the fact that hardly any women are exposed to mining dust, since mining is not an occupation in which women are commonly found. Some further work needs to be done to establish the combined effects of smoking and dust in causing COPD. The mechanism of the relation between COPD and smoking is not at present completely understood. It is not simply the number of cigarettes smoked; some other factors, such as silica dust, also may cause COPD.[11]

In the case of COPD among young people, giving up smoking leads to the improvement of their lung function. However, in older people, such as many ex-mineworkers, such an improvement is not possible; although after cessation of smoking further deterioration will run parallel to that of non-smokers. Krishna et al., on the other hand, found that the FEV1 was significantly lower in smokers than in non-smokers and ex-smokers.[14] The risk of lung cancer, like all other cancers, increases steeply with advancing age. When smokers give up smoking, their risk of getting lung cancer starts decreasing so that after 10 to 15 years an ex-smoker's risk is only slightly greater than that of someone who has never smoked.[15] Other factors can cause lung cancer but they are much less important than smoking.[16] For smokers who are exposed to substances such as asbestos, their risk of developing lung cancer tends to multiply and become very large. The International Agency for Research on Cancer (IARC, 1987) has identified crystalline silica as a potential human carcinogen; most mineworkers are exposed to silica in their underground mining work. There is confusion though about the role of silica in causing lung cancer among mineworkers who are frequently exposed to silica and who also smoke. There is again a need for a case control study about the potentiality of silica inhalation and smoking in causing lung cancer.

The respiratory system is vital to life, and anything that prevents it from functioning can result in death. Often cancers of the respiratory system are not discovered until it is too late to cure them: less than 8% of lung cancer patients are alive five years after diagnosis.[17] In countries where smoking has been widespread for many years, the typical pattern of smoking induced deaths are from lung cancer and another quarter are from chronic obstructive lung diseases: bronchitis and emphysema. An ex-mineworker with lung cancer may have smoked cigarettes, had diagnostic X-rays and been occupationally exposed to silica dust in gold mines, so since occupational lung cancer does not have distinctive clinical features, an expert medical witness, using clinical judgment, cannot say that the disease is without question occupational in origin. The expert witness cannot say with certainty that the occupational exposure to silica dust was one of several causes of the cancer.[18] The lung abnormalities are progressive in non smokers, from 3% in the young age group (30-39 years) to 20% in the terminal age group (60+ years). This picture is different in smokers and ex-smokers, as the lung abnormalities rise sharply from 23% to 24% in middle age group i.e. 40 to 59 years.

The characteristic feature of all these groups is the progressive nature of their susceptibility to acquiring lung abnormalities, with fewer risk factors in the youngest and healthiest group and more in the older group. Lung abnormalities, it is found, are least in the youngest age group of 30-39. Susceptibility to diseases of the lungs is progressive, especially in the middle aged groups from 40-59 years of age, ranked progressively at 5%, 18% and 21%. Again, the phenomenon of lung cancer is prominent in smokers and ex-smokers among ex-mineworkers. There is a link between smoking along with dust inhalation in the causation and progression of lung disease, but the proportion is difficult to estimate. Examining the health of non-smoking mineworkers, which correlates with the lung abnormality of smokers and ex-smokers, has created doubts about the contribution of tobacco smoking alone to the condition of the health of mineworkers. In non-smokers, there is an end point at the level of about six percent (6%) in the terminal age groups. This is not so among the smokers.

Lung abnormalities are predominant in ex-smokers (30%), in smokers (23%), and men who had never smoked (10%). This contrasts with the absence of abnormalities in ex-smokers (19%), smokers (7%), and non smokers (10%). Almost half (a ratio of 1:1) of the non smokers have no lung abnormalities, more than half of the ex-smokers (2:3) are sick, and smokers are a majority (1:3) of those found to be sick as far as lung abnormality

is concerned. There is a marked relationship between smoking and lung abnormality, with a p value of <0.05, and Chi-square at 16.64. It is highly significant, indicating that smoking has a higher association with lung abnormalities (Table IX).

Table IX: History of smoking vs. lung abnormality detected in ex-mineworkers of the Transkei.

History of Smoking	Lung Abnormality Detected	Lung Abnormality not detected	Total
Ex-smokers	137 (29%)	89 (19%)	226 (48%)
Smokers	107 (23%)	36 (8%)	143 (31%)
Non smokers	48 (10%)	49 (11%)	97 (21%)
Total	292 (63%)	174 (37%)	466 (100%)

Chi square= 16.64 p value 0.0002 (Statistically highly significant).

There is a marked relationship between smoking and lung abnormality, with a p value of 0.0037, and Chi-square of 8.39, and Odd ratio of 2.00. It is highly significant, indicating that smokers are twice as vulnerable to lung abnormalities as non smokers (Table X).

Table X: Association between smoking and lung abnormality in ex-mineworkers of the Transkei.

History of smoking	Lung Abnormality	No lung Abnormality	Total
Smoking including ex-smokers	244 (52%)	125 (27%)	369 (79%)
Non-smoking (Never)	48 (10%)	49 (11%)	97 (21%)
Total	292 (63%)	174 (37%)	466 (100%)

Chi-square=8.39 p value 0.0037 OR=2.00 (Statistically highly significant).

Many of those concerned with awarding mineworker compensation in South Africa believe that the disability documented in silicotic subjects and other mineworkers exposed to silica results from cigarette smoking rather than from silicosis. Considering this, and the possibility of an etiological association between silicosis and smoking, it has become apparent that smoking may seriously confound studies of silicotic subjects either directly or indirectly.[19] Increased risk of developing lung cancer depends upon the age when a person starts smoking.

The younger a person is when he starts smoking, the greater the risk of developing lung cancer, especially among mine workers. Death rates increase approximately in proportion to the duration of smoking: doubling the duration of smoking from 10 to 20 years increases the incidence of lung cancer 16 times if daily cigarette consumption remains constant.[20]

The periodic examination of the condition of the lungs of miners in the South African mining industry was evaluated by determining the number and nature of abnormalities. It is suggested that the time between examinations can be extended, especially for younger workers, and that follow up of significant conditions can be undertaken more effectively if the examinations are conducted at the workplace.[21] Unfortunately, non smoking is hardly considered as either part of education strategy or promotion of health in mineworkers by their employers; it is my view that non smoking should be rewarded or an incentive attached to it.

In this study no socioeconomic factors were found to be influencing patterns of smoking and there was no association with social participation. These findings have important implications for the discussion on social capital and preventive measures.[22] Antidepressant drugs may work well to help the more severely addicted to quit. These drugs should be used in addition to nicotine substitutes, and must only be prescribed under medical control.[3] Counseling by doctors and nurses, behavioral interventions (individual counseling or group therapy), nicotine replacement treatment and several pharmacological interventions (such as antidepressants, bupropion and nortriptyline) increase smoking cessation rates.[23] In people trying to quit smoking, nicotine replacement treatments are effective in achieving smoking abstinence for between 6 and 12 months at a time.[24] Smoking is likely to relate to the predominant presence of tuberculosis.[24] It is likely, therefore, that there is an additive effect of smoking with tuberculosis in producing obstruction of the airways.[25]

The effects of tobacco use may be worsened by the incidence of infectious disease and environmental hazards in developing countries, which may cause increases in certain cancers. For example, tuberculosis is endemic in many less-developed countries and the risk of lung cancer is believed to be enhanced by the presence of tuberculosis. Occupational hazards such as mining dust; uranium or asbestos may act as synergistic carcinogens on workers.[26] The results show that the risk of pulmonary tuberculosis increases with the presence of radiologically diagnosed silicosis, with increasing cumulative exposure to silica dust, and with tobacco pack years. The presence of silicosis diagnosed radiologically increased the risk of pulmonary tuberculosis by about four times after adjustment for cumulative dust and smoking.[27]

A majority of mineworkers in the Transkei are infected with tuberculosis. This high vulnerability to pulmonary tuberculosis is due to either excessive exposure to silica dust, tobacco smoking or both.[1]

Conclusion

Tobacco smoking ex-mineworkers live with a much more deteriorated state of health than non-smokers. It seems that the role of dust and smoking is an additive in the causation of lung abnormalities. The mining owners have obligations to their employees, enshrined in the Occupational Safety and Health Act, 1993, regarding the health care of mineworkers. The provisions of this Act should be extended to ex-mineworkers as well. Most of the time, the measures taken by the mining health care advisers are either protective or curative in nature, but not preventive. Education regarding the bad effects of tobacco consumption and the rights of non-smokers should be incorporated in the practice at the workplace under this Act.

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