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Prevalence and trends of smoking in South African platinum miners

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Chapter One

1.0 INTRODUCTION

Tobacco use, particularly cigarette smoking, is an important cause of disease. At the 11th World Conference on Tobacco OR Health held in 2000[1], tobacco smoking was highlighted as a disease emerging as a global epidemic since the toxic components in tobacco smoke have been linked to heart and lung diseases. It is a known or probable cause of some 25 different diseases and, for some diseases, such as lung cancer, bronchitis and emphysema, it is the major cause[2]. Race, education and living standards have also been shown to be clearly associated with knowledge about smoking and its related diseases[3]. Tobacco and smoke are of concern to smokers and non-smokers alike as smoking also has adverse effects on non-smokers who are exposed to tobacco smoke[4,5].

A study in India revealed that the death rates from medical causes of "ever smokers" were twice those of "never smokers"[6]. Smokers who stop smoking before they develop cancer or some other serious disease can considerably reduce their risk of death from tobacco[7]. Another study in China[8] found that smoking was more predictive of premature mortality than overall occupational exposures in middle-aged workers where 12% of deaths could be attributed to smoking and 3% to occupational exposures if there was a causal relationship.

1.1 Global burden of smoking

About a third of the male adult global population smokes[9]. Smoking-related diseases kill one in 10 adults globally. The prevalence of smoking is falling in developed countries but is rising in developing countries at a rate of 3.4% per year[9].

1.2 Burden of smoking in South Africa

Smoking prevalence (number of smokers) and consumption (number of cigarettes smoked) in South Africa have been on the decrease since 1993. Aggregate cigarette consumption decreased by 26% in South Africa from 1993 to 2000[10]. Smoking prevalence has also been decreasing in most demographic and socio-economic groups. Reddy et al.[11], during a smoking survey in 1997, found that race, gender, age and education were related to smoking status and that health warnings triggered the desire to quit or cut down smoking. A study by van Walbeek[10] in 2000, indicated that smoking prevalence in adults over the age of sixteen was 43.8% for males, 11.7% for females, and 27.1% overall. They also calculated that smoking prevalence decreased from 32% to 27% in the adult population from 1993 to 2000. This was ascribed mainly to the sharp increase in cigarette prices. Sixty per cent of the decrease in per capita cigarette consumption was due to a reduction in average consumption of smokers. The remaining 40% was due to decreased prevalence[10].

A 2001 study by the Economics of Tobacco Control Project of the University of Cape Town revealed that around eight million South Africans smoke[12]. Between 1990 and 1999 per capita cigarette consumption in South Africa decreased by about 40%[12]. This is slightly different from the 26% decrease between 1993 to 2001[10]. Presently, as reported by the press in 2003, South Africans are smoking less[13]. However, one in nine deaths nationally are still reported to be related to tobacco use[14].

Smoking is of particular concern in employed people. It has become a major public health issue that demands urgent action and particularly on the mines, as smoking prevalence is generally higher among people employed in labour-intensive industries[12]. Workers who smoke cigarettes tend to have higher absenteeism, medical costs, and more accidents and injuries than non-smokers[7]. In the United States, where the value of "on the job" smoking is added, the total direct and indirect costs of hiring a smoker and allowing that person to smoke at work can be as much as an additional $5000 per year. Healthy workers have the potential to be more productive than workers who follow unhealthy lifestyles, indicating that health promotion at the work site is a sound financial investment[7,15].

1.3 Health Effects of Smoking in South African miners

Although there are no data available, it is likely that the prevalence of smoking in miners is similar to, if not higher than, that in the general population. Miners who

smoke are at higher risk of developing lung diseases than the general population due to the fact that the dust particles have an interactive effect with occupational exposures increasing the likelihood of tuberculosis, coal workers' pneumoconiosis, lung cancer and Chronic Obstructive Pulmonary Disease[16],[17]. Smoking potentiates the effect of dust on respiratory impairments[18].

Disability due to smoking such as Chronic Obstructive Pulmonary Disease (COPD), Pulmonary tuberculosis (PTB) and lung cancer has become increasingly prominent[16,19,20] and may be a consequence of increased tobacco consumption over the years. There is some evidence to suggest that smoking enhances the retention of asbestos fibers in the lungs even though pathologic studies have not shown an association between asbestosis and smoking[21]. So, gold miners are probably at greater risk than asbestos miners.

In a study on coal miners by Naidoo et al[20], smoking was associated with PTB, silicosis, emphysema and cancer in South Africa. Nery et al.[22] confirmed that controlling smoking is important in minimising the respiratory consequences of silica related illness in exposed working populations.

Some of the most serious effects of smoking posing a threat to working populations exposed to high dust and noise levels are: COPD, lung function impairment, PTB, lung cancer and hearing loss.

1.3.1 Chronic Obstructive Pulmonary Disease and lung function impairment in miners

Three disorders are incorporated in COPD, viz. emphysema, peripheral airways disease and chronic bronchitis. Epidemiological studies have identified a number of risk factors for COPD, including age, gender, past and present respiratory illnesses and genetic characteristics. However, the most important external risk factor is tobacco smoking[23,24,25,26]. Silica dust is also an important risk factor and acts synergistically with smoking in causing COPD[27,28]. The loss of lung function associated with the effect of dust alone very rarely causes serious respiratory disability[29]. However, a study on miners in 1997 showed that the combined effect of dust and smoking is responsible for a large proportion of cases of serious disability, and that the elimination of tobacco smoking could have prevented most of these cases[30]. Lung function impairment, in association with chronic bronchitis, increases risk of mortality from COPD[31]. A recent review confirmed the adverse effects of smoking and the interaction between silica exposure and smoking in the development of COPD, thus making smoking cessation programmes particularly important for silica exposed miners[18].

There is also epidemiological evidence that cigarette smoking increases the risk of loss of lung function. Hnizdo[29] revealed that the combined effect of silica dust and smoking had the potential to decrease lung function to the extent that gold miners were more likely to become disabled than the non-miners as they had a greater loss of lung function from 50 to 55 years of age than that predicted for a

the general population. Among coal miners, smoking was associated with a loss of lung function equivalent to a loss of five years breathing capacity over a lifetime period of employment[20].

1.3.2 Pulmonary Tuberculosis in miners

Silica exposure, even in the absence of silicosis, is a well known risk factor for PTB[30]. However, there is also evidence that the risk of PTB increases in South African miners with increasing tobacco pack-years[32]. "Ever smokers" are at higher risk of developing PTB than "never smokers"[6,33].

1.3.3 Lung cancer in miners

Smoking is the strongest risk factor for developing lung cancer[23,34]. However, epidemiological studies provide evidence that there is also an increased risk of lung cancer in smokers with silicosis[30,35] . In 1997, silica dust was declared to be a carcinogen for lung cancer by the International Agency for Research on Cancer[30]. A study revealed that men with lung function test results consistent with airways obstruction had an increased risk of lung cancer[36]. Another study, in South East Asian tin miners, reported that daily cigarette consumption and number of years smoking were independent contributors to risk of lung cancer[37]. The risk of lung cancer in asbestos exposed individuals is greatly enhanced by cigarette smoking, although the long-accepted multiplicative model has recently been challenged[19].

Radon is another well-established carcinogen in mining[32,38,39,40]. There is a multiplicative effect of radon-progeny exposure and current smoking in mining in the risk of lung cancer[35]. Factors that may influence this relationship are exposure rate, time since exposure, smoking status and attained age. In an ecological study in the United States, Puskin,[41] found that there was negative correlation between lung cancer mortality and average radon levels by county but this was not substantial evidence for a protective effect of low level radon exposure. Stopping smoking can substantially reduce the risk of lung cancer associated with radon exposure[36].

1.3.4 Hearing impairment and smoking

Smoking has been reported to be a risk factor for hearing impairment in workers with or without occupational exposure to noise[42,43]. Even though there is limited evidence for the type of association that exists between smoking and occupational exposure to noise, smokers have been shown to have a greater risk of hearing loss than non-smokers[43,33]. However, some studies have described the combined effect of smoking and noise to be more consistent with an additive than multiplicative effect[42,44].

1.4 Economic burden and compensation

The diseases that have smoking as well as mine dust and radon as risk factors, place a great economic burden on the mines, as they are compensable under the Occupational Diseases in Mines and Works Act[45]. The compensation

commissioner does not take smoking into account, i.e. disease whch is compensable under the Act (e.g. COPD, lung cancer, pneumoconiosis, emphysema) will be considered for compensation, regardless of whether or not the person smoked. The impact of these diseases reduces the quality of life of miners and promotes premature retirement and death. The total direct costs of occupational lung disease in the gold mining industry were estimated in 1996 as R343 million[45].

1.5 Motivation for the study

The high risk, associated with cigarette smoking, of developing respiratory diseases on the mines is an important issue that needs to be addressed. The Mine Health and Safety Act of 1996 (MHSA) requires employers to take measures to assess and reduce the risk of occupational diseases; one way to enhance prevention would be to reduce prevalence of smoking. There is a high prevalence of smoking in white gold miners[46] but there are no published data on black miners or miners in other sectors. There is no information on cigarette consumption and the association of smoking with demographic factors in South African miners. There are also no data on whether the rate of smoking is increasing or decreasing in miners.

In terms of legislation (Mine Health and Safety Act, 1996), all miners undergo routine annual medical surveillance tests/examinations that include physical examination, chest x-ray and lung function testing.

The mining company that is the focus of this current study also records additional information on smoking. The opportunity arose to study smoking prevalence and trends in a large number of South African platinum miners for whom the data from annual surveillance examinations are computerized. At the time of this study, there was no computerised database with smoking information in the gold mines. However, a large number of platinum mine employees are ex-gold mine

employees. Platinum is becoming more profitable to mine than gold in South Africa, leading to a shift of workers either voluntarily or after retrenchment from the gold mines to the platinum mines. These miners move with accumulated exposure of silica.

The results of this study may have several implications including providing information useful for the implementation of smoking cessation and prevention programmes. It is vital that the mining industry addresses the problem of respiratory health holistically by using all practicable means to prevent lung diseases.

1.6 Study objectives:

- To determine the prevalence of smoking and cigarette consumption in mine employees in a platinum mining company from 1998 to 2002
- To describe smoking and consumption trends among these mine employees from 1998 to 2002
- To examine potential socio-demographic factors associated with smoking i.e. race, age, gender and job grade (as proxy for education).

Chapter Two

2.0 MATERIALS AND METHODS

2.1 Study Design

The study design was cross sectional and entailed a secondary data analysis of routine medical surveillance data collected from 1998 to 2002.

2.2 Study Setting

The largest reserve base of platinum-group metals is found in South Africa and the platinum mining companies comprise one of the Country's biggest employers with more than 100 000 employees. In 2000, platinum metals to the value of $3.9 billion were exported from South Africa. This study used data from one of the oldest platinum mining companies in South Africa.

2.3 Study Population and subjects

The study population comprised all black and white mine employees who underwent annual medical examination from 1998 to 2002, inclusive. There were 25324 miners with 80713 records of full time employees for whom the data from ongoing annual surveillance examinations were computerized.

2.4 Study variables

The database comprised routine medical surveillance records collected from employees of one of the oldest platinum mining companies in South Africa.

The following variables, derived from the computerized data collected were used in the analysis:

1. **Study number** – A unique number assigned to every study subject
2. **Year of interview –** Year of medical examination
3. **Age –** Age of respondent at the first recorded medical examination. Ages were categorized into age groups viz.

   < 25 years

   25 – 34 years

   35 – 44 years

   45 – 54 years

   55 – 66 years

4. **Smoking status**:

   Always-smoker – An employee who reported that he/she smoked at every medical examination during the study period.

   New-smoker – An employee who started smoking during the study period.

   Ex-smoker – An employee who stopped smoking during the study period.

   Never-smoker – An employee who never smoked during the study period.

Ever smoker – An employee who reported smoking at least once during the study period.

5. **Cigarette consumption**–The number of cigarettes smoked per day as follows:

   Light - less than 10 cigarettes

   Moderate – 10 to 19 cigarettes

   Heavy – 20 or more cigarettes

6. **Job grade** – As categorized by the mining company and recorded on the database as follows:

   A – Low grade workers such as labourers and some miners

   B – Other low-grade workers such as miners and clerks distinguished from grade A only by salary.

   C – Middle grade workers, mostly artisans or blue-collar workers.

   D – A blend of top grade workers such as junior and senior managers.

7. **Race** – Mine employees were categorized as black, white, coloured or Asian.

8. **Gender** – Male or female

2.5 Data Analysis

Data were analyzed using the epidemiological package Epi-Info and the statistical package STATA (version 7). The main outcome variables in the study were smoking status and cigarette consumption. The independent variables were age, race, gender, and job grade.

Simple frequency distributions were produced for all the variables overall and for each year of study. Unknown job grades were used in basic frequency distributions but were excluded from further analysis of job grades. Subjects whose race was mixed or Asian were excluded from the analysis as numbers were too small.

Analysis of variance was used to compare the differences in the mean cigarette consumption by race, age group, job grade and gender during the study period.

Smoking prevalence and cigarette consumption were calculated for each year of the study for all mine employees. Trend analyses over the five year period were performed for smoking prevalence and associated factors, viz race, age group and job grade, using a chi square for trend. However, to deal with confounding effects of some explanatory variables in measuring trends, multivariable analysis was done over the study period. The mean number of cigarettes smoked was used in the analysis rather than the median, as it is easier to fit regression models to the mean. The trend in cigarette consumption (number of

cigarettsmoked) was examined using a mixed model for repeated measures (to account for the fact that some subjects had multiple records i.e. they were in the study for 2 or more years).

“The analysis took into account the fact that workers could be included in the data in a number of years and the responses for the same worker in different years will not be independent. This was done in the following ways:

(a) In the terminology of the Statistical package Stata, a “wide” data set was created in which the profile of smoking status for the worker over the 5 year period was presented. Using this profile, each of the 25,324 workers could firstly be classified into one of two categories, namely “ever smoked” (if they smoked in 1 or more of the years) and “never smoked” (if they were non-smokers in every year for which data was available). The ever smokers could then be further classified into one of three groups namely

(i) Always smokers, who were smokers in every year for which data were available

(ii) New smokers - if the subject was initially a non-smoker, and then later became a smoker and remained a smoker.

(iii) Ex-smoker – An employee who stopped smoking during the study period.

For the smokers, the mean number of cigarettes smoked was calculated by averaging over all of the years.

An “aggregated” analysis was carried out, firstly of factors that distinguish between ever smokers and never smokers, using a multiple logistic regression analysis on the summary records corresponding to the 25,324 workers; in this case the assumption of independent observations was valid as only one record was analysed per subject. Similarly an aggregated analysis was carried out to find factors that affect the number of cigarettes smoked, given that the individual was an ever smoker.

(B) The fact that observations for a given worker in successive years are not independent can be accommodated by fitting multilevel models, also known as mixed models or hierarchical linear models. These models have now become the accepted standard of analysis for longitudinal or repeated measures data[47]. These models were fitted using the “xt” commands in Stata.

The strength of the associations between smoking and cigarette consumption as outcome variables and associated factors were derived using multivariable analysis (multiple regression and multiple logistic regression) over the period of study. Confounders were controlled for by the regressions.

All analyses were done at the 5% significance level and using 95% confidence intervals (CI).

Chapter 3

3.0 RESULTS

3.1 Demographics

The demographics of the study population at entry into the study during the period under review are presented in table 3.1. There were 25274 employees in the study, with a total of 80713 records from 1998 to 2002. Only white and blacks were included in the analysis. The majority of employees were males (97.4%) out of which 87.5% were blacks. Other racial groups (Asians and mixed race) were excluded, as they comprised a small proportion of all mine employees (0.2%). 86.3% were 25 – 54 years of age. Most (58.4%) were miners, labourers or clerks (grades A and B); only a small percentage (1.5%) was middle and top grade workers (grades C and D) and a large percentage of jobs were not categorized (37.7%). The age distribution of mine employees was relatively normal with mean and median ages of 38.2 and 38.9, respectively.

Table 3.1: Demographic characteristics of platinum mine employees at entry into study

Characteristic	**Black N% 22120 (87.5%)**	**White N% 3154 (12.5%)**	Total **N% 25274 (100%)**
Gender			
Male	21748 (98.3)	2858 (90.6)	24606(97.4)
Female	370 (1.7)	296 (9.4)	666(2.6)
Unknown	2 (0.0)		2(0.0)
Age group			
< 25	1629 (7.4)	975 (30.9)	2604 (10.3)
25 – 34	5108 (23.1)	888 (28.2)	5996 (23.7)
35 – 44	10101 (45.7)	826 (26.2)	10927 (43.2)
45 – 54	4496 (20.3)	401 (12.7)	4897 (19.4)
55 – 66	786 (3.6)	64 (2.0)	850 (3.4)
Job grade A	1538 (6.9)	6 (0.2)	1544 (6.1)
B	13126 (59.3)	80 (2.5)	13206 (52.3)
C	284 (1.3)	488 (15.5)	772 (3.1)
D	36 (0.2)	176 (5.6)	212 (0.8)
Unknown	7136 (32.3)	2404 (76.2)	9540 (37.7)

The high labour turnover is reflected in figure 3.1 i.e. seventy percent of employees were employed for three or more years during the study period. 18% and 12% of mine employees had records for only 1 and 2 years, respectively. From personal communication with the mine health officer, each year over 90% of the employees records were included in the data.

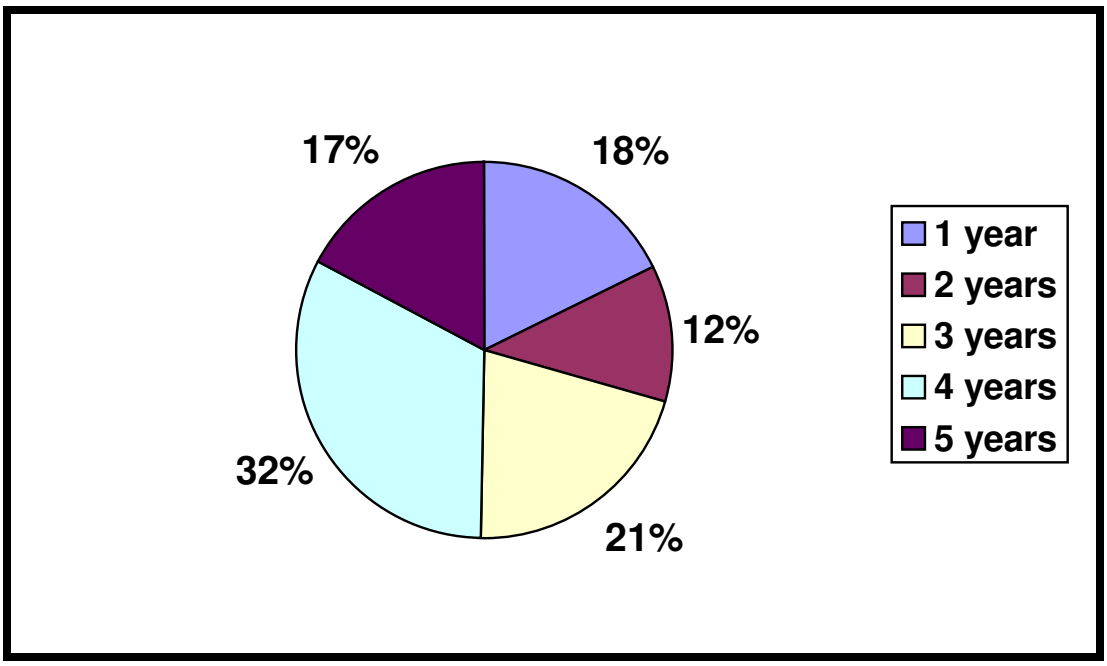


Figure 3.1: Distribution of subjects by the number of years of participation in the study

3.2 Smoking status

Overall, most employees never smoked (55.6%). 23.1% were smokers throughout the study period. A very small proportion of employees started smoking during the study period (4.8%) and 18.4% gave up smoking during the study period.

3.2.1 Smoking status by race

Table 3.2 shows the smoking status of employees over the study period by race. More blacks had never smoked in the study period than whites (56.1% and 52.2%, respectively). A higher proportion of blacks stopped smoking (44.8%) compared to whites (19.2%). Very few mine employees started smoking during the study (5.0% blacks and 4.0% whites) and some mine employees were smokers throughout (21.3% blacks and 35.4% whites).

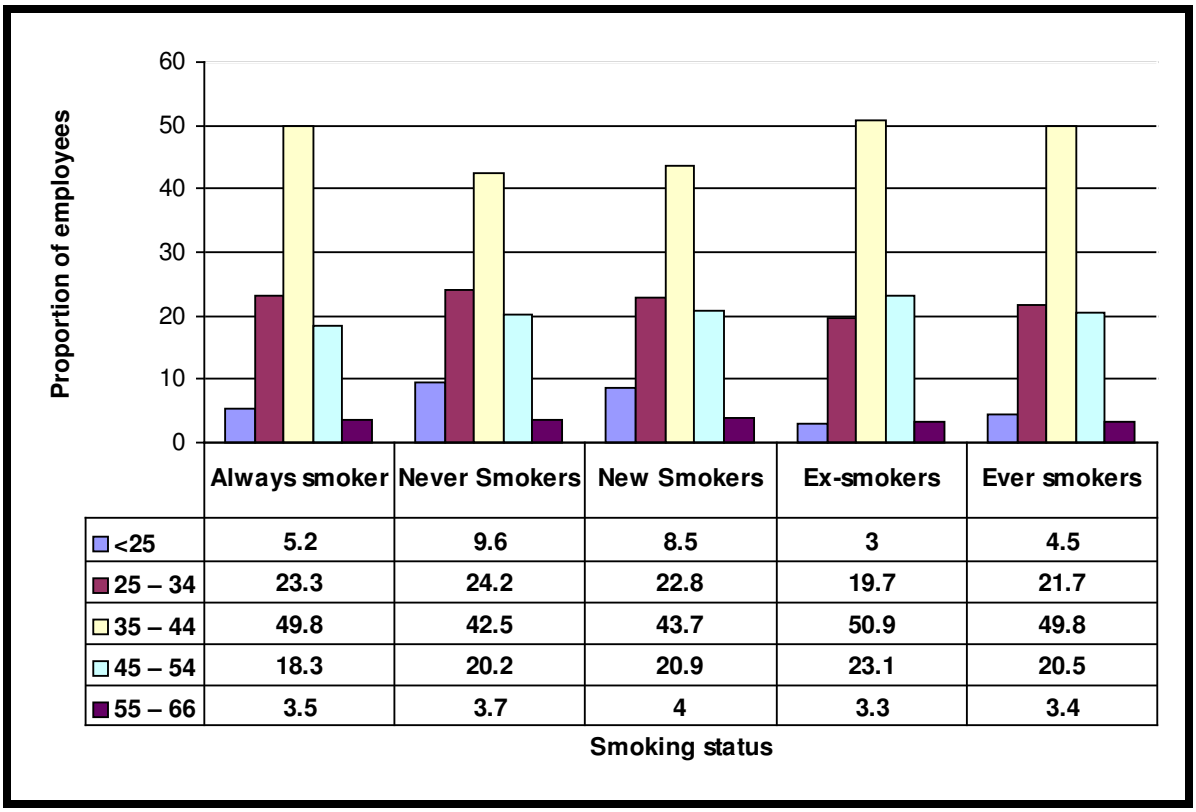
Table 3.2: Smoking status of employees by race

Smoking Status	**Race**		
	Black **N (%)**	**White** **N (%)**	**Total** **N (%)**
Never smokers	12399 (56.1)	1647 (52.2)	14046 (55.6)
Always smoker	4716 (21.3)	1115 (35.4)	5831(23.1)
Ever smokers	9721 (43.9)	1507 (47.8)	11228(44.4)
*New smokers	1095 (5.0)	122 (3.9)	1217(4.8)
*Ex-smokers	4355 (44.8)	290 (19.2)	4645 (18.4)

* Note that these two categories are not mutually exclusive as someone could both start and quit during the 5 year period.

3.2.2 Smoking status by age group and race

Figure 3.2 shows smoking status of employees by age group for blacks. In all smoking categories, employees older than 54 years made up the smallest proportion and the highest proportion of employees were aged 35 –44 years. The smallest proportion of ex-smokers were younger than 25 (3.0%). There were similar distributions of employees by age group in all categories.

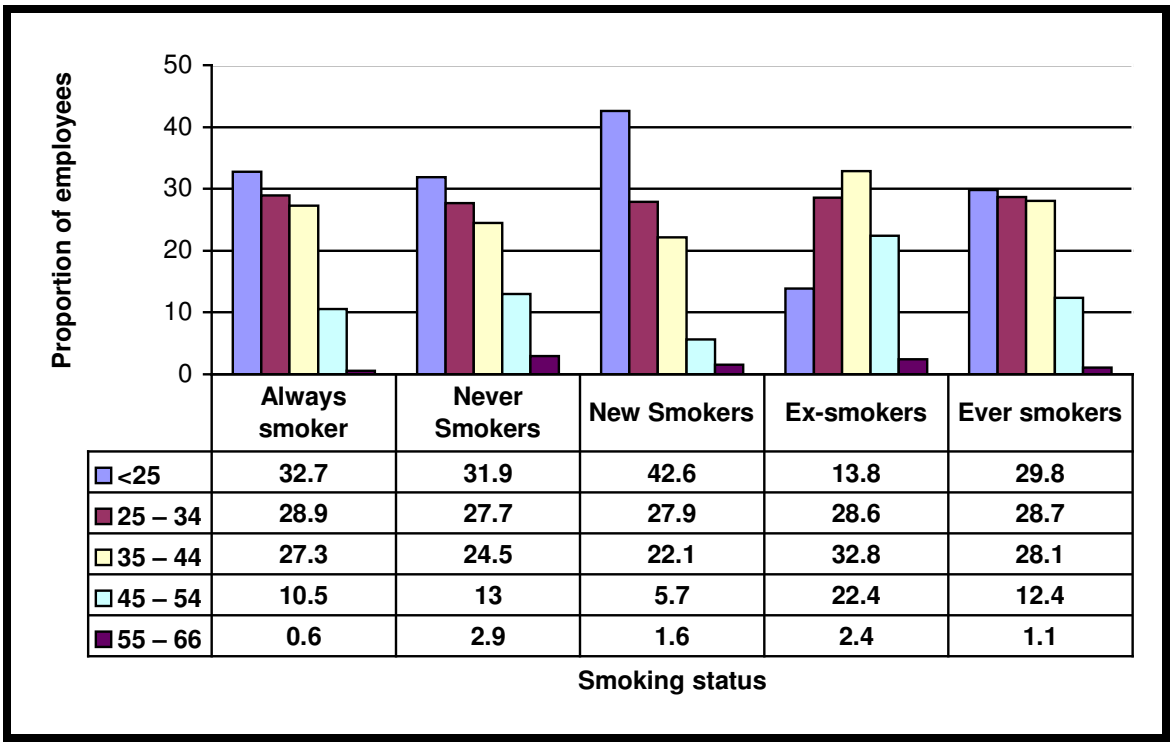


	Always smoker	Never Smokers	New Smokers	Ex-smokers	Ever smokers
<25	5.2	9.6	8.5	3	4.5
25 – 34	23.3	24.2	22.8	19.7	21.7
35 – 44	49.8	42.5	43.7	50.9	49.8
45 – 54	18.3	20.2	20.9	23.1	20.5
55 – 66	3.5	3.7	4	3.3	3.4

Figure 3.2: Smoking status of employees by age group: Blacks

The age groups by smoking status differed for whites (figure 3.3). The distribution of white employees by age group was skewed for all smoking status categories. There were similar proportions of employees in always, never, and ever smokers

categories with the highest proportions in the youngest and the lowest proportions in the oldest age groups. However, the highest proportion of ex-smokers was in 35-44 year olds (32.8%) and the lowest in those older than 54 years (2.4%). Most new smokers were younger than 25 years.



	Always smoker	Never Smokers	New Smokers	Ex-smokers	Ever smokers
<25	32.7	31.9	42.6	13.8	29.8
25 – 34	28.9	27.7	27.9	28.6	28.7
35 – 44	27.3	24.5	22.1	32.8	28.1
45 – 54	10.5	13	5.7	22.4	12.4
55 – 66	0.6	2.9	1.6	2.4	1.1

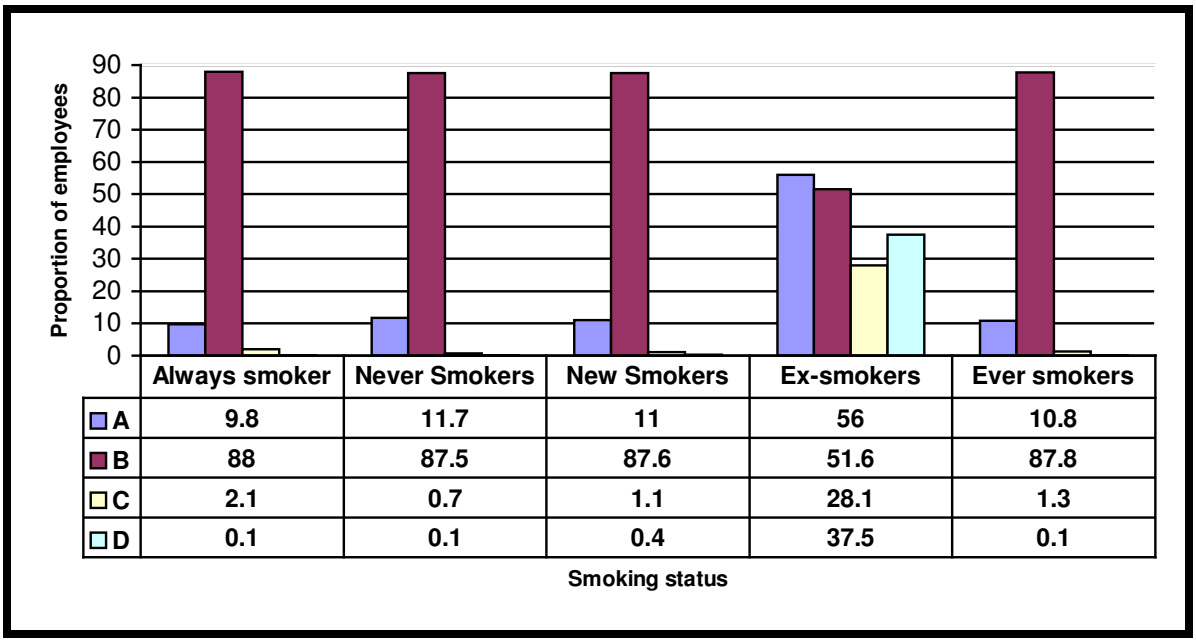
Figure 3.3: Smoking status of employees by age group: Whites

3.2.3 Smoking status by job grade and race

Figure 3.4 shows smoking status of employees by job grade for blacks. There were similar proportions of employees from each job category in the always, never, ever and new smoking status categories. The highest proportions were in job grade B. There were negligible proportions of employees in Job grades C and

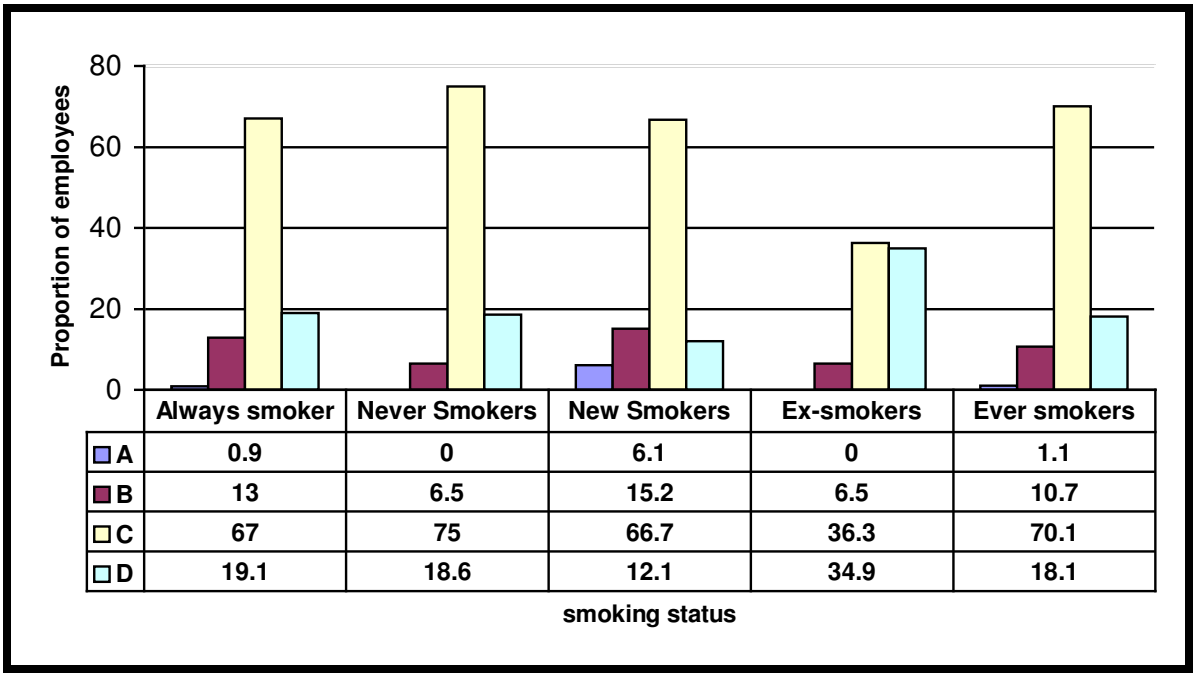
D. The pattern differed for ex-smokers where the highest proportion was in job grade A (56%) and the lowest in job grade C (28.1%).

Figure 3.5 shows smoking status of employees by job grade for whites. The highest proportions of employees in all smoking status categories were in job grade C followed by job grade D except for new smokers that had a higher proportion in grade B (15.2%). Ex-smokers had high proportions in both grades C and D.



	Always smoker	Never Smokers	New Smokers	Ex-smokers	Ever smokers
A	9.8	11.7	11	56	10.8
B	88	87.5	87.6	51.6	87.8
C	2.1	0.7	1.1	28.1	1.3
D	0.1	0.1	0.4	37.5	0.1

Figure 3.4: Smoking status of employees by job grade: Blacks



	Always smoker	Never Smokers	New Smokers	Ex-smokers	Ever smokers
A	0.9	0	6.1	0	1.1
B	13	6.5	15.2	6.5	10.7
C	67	75	66.7	36.3	70.1
D	19.1	18.6	12.1	34.9	18.1

Figure 3.5: Smoking status of employees by job grade: Whites

3.3 Cigarette consumption

The distribution of the number of cigarettes smoked by mine employees was slightly skewed with mean and median number of cigarettes smoked per day of 6.4 and 5.0, respectively. Table 3.3 shows the cigarette consumption of employees the first time they ever reported as being smokers in the study period. The majority (78.7%) of smokers were light smokers; only a small proportion of these were heavy smokers.

Table 3.3: Cigarette consumption of employees over the study period

Cigarette Consumption category	FREQUENCY	
	n	%
Light	8832	78.7
Moderate	1880	16.7
Heavy	516	4.6
Total	11228	100

3.3.1 Cigarette consumption and race

White mine employees smoked, on average, nine more cigarettes per day than black mine employees; this difference was significant (p=0.001). There was a higher proportion of light smokers among blacks (87.2%) compared to whites (23.5%) as shown in figure 3.6. There were also higher proportions of moderate and heavy smokers combined amongst whites (76.5%) compared to blacks

(12.8%). The difference between whites and blacks for all smoking categories was significant (p<0.001).

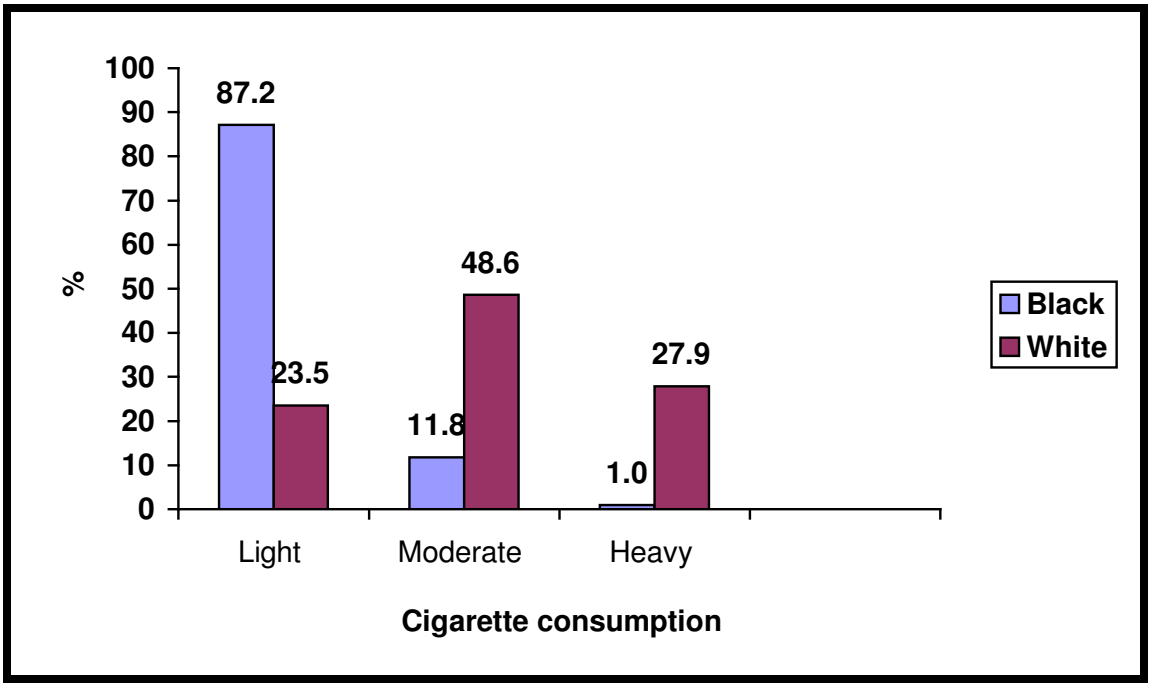


Figure 3.6: Smoking prevalence in various consumption categories by race

3.3.2 Cigarette consumption, age group and race

Mine employees younger than 25 smoked, on average, eight cigarettes per day; those older than 54 smoked an average of five cigarettes per day. The differences in the mean number of cigarettes smoked per day per age group were small but significant (p<0.001). Cigarette consumption was generally higher among mine employees aged 35 to 44 years and lowest among those aged 55 to 66 years. The overall distribution of consumption by age group was normal but the proportions in each age group were significantly different (p<0.001). In black mine employees; the highest

proportion of smokers in each category (light, moderate and heavy) was in the 35 to 44 years age group and lowest in those younger than 25 years (figure 3.7). However, the distribution in whites was skewed, with most light smokers younger than 25 years (figure 3.8). White mine employees aged 25 to 34 years and those aged 35 to 44 years had a relatively higher proportion of heavy smokers than those of other ages. The difference in smoking proportion between age groups was significant for both races ($p<0.001$).

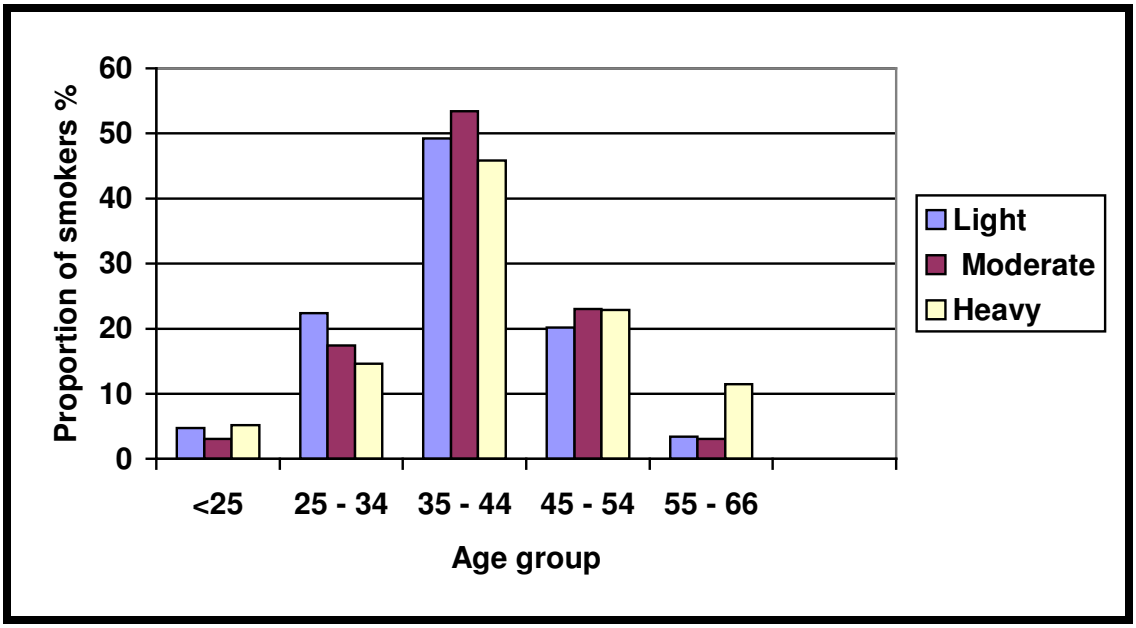


Figure 3.7: Distribution by age group and cigarette consumption: Black mine employees

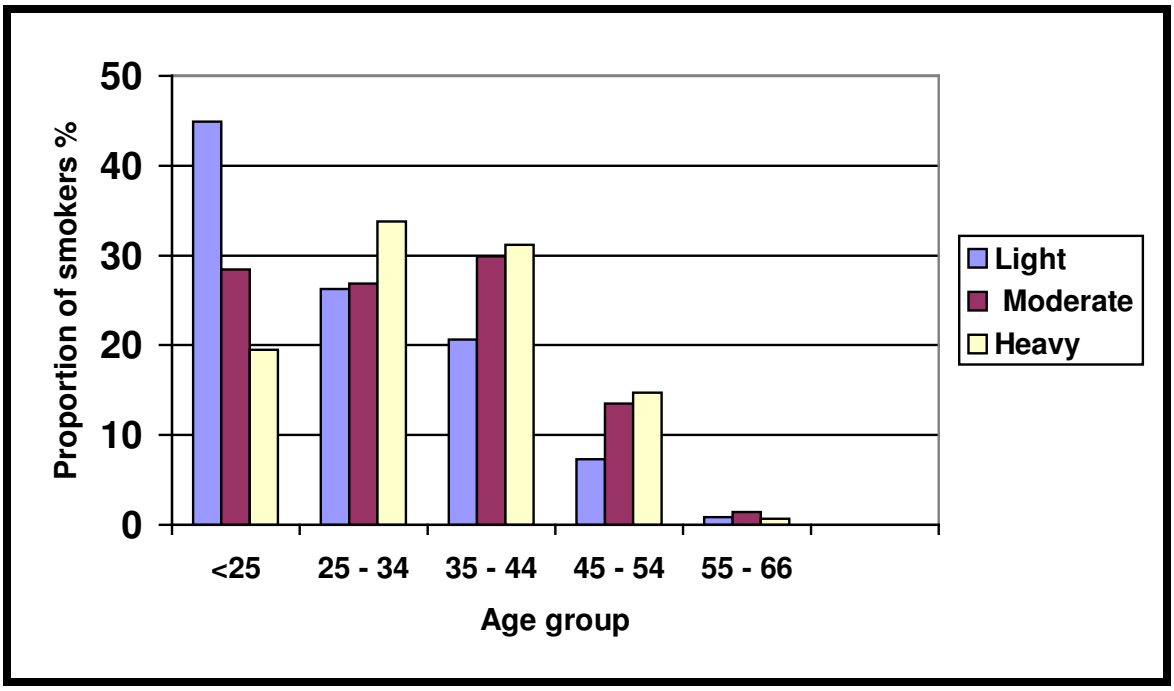


Figure 3.8: Distribution by age group and cigarette consumption: White mine employees

3.3.3 Cigarette consumption and gender

Women smoked more than men (10 cigarettes compared to 6 cigarettes per day by men). However, it is worth noting that of the 11228 employees who ever smoked there were very few females (1.0%) compared to males (99%) and so this finding should be interpreted with caution.

There was a similar distribution for cigarette consumption categories in males and females with the highest proportions among light smokers and the lowest among heavy smokers (figure 3.9). The proportions of females that were moderate and heavy smokers were higher than those of males, but for light smokers the proportion of females was lower.

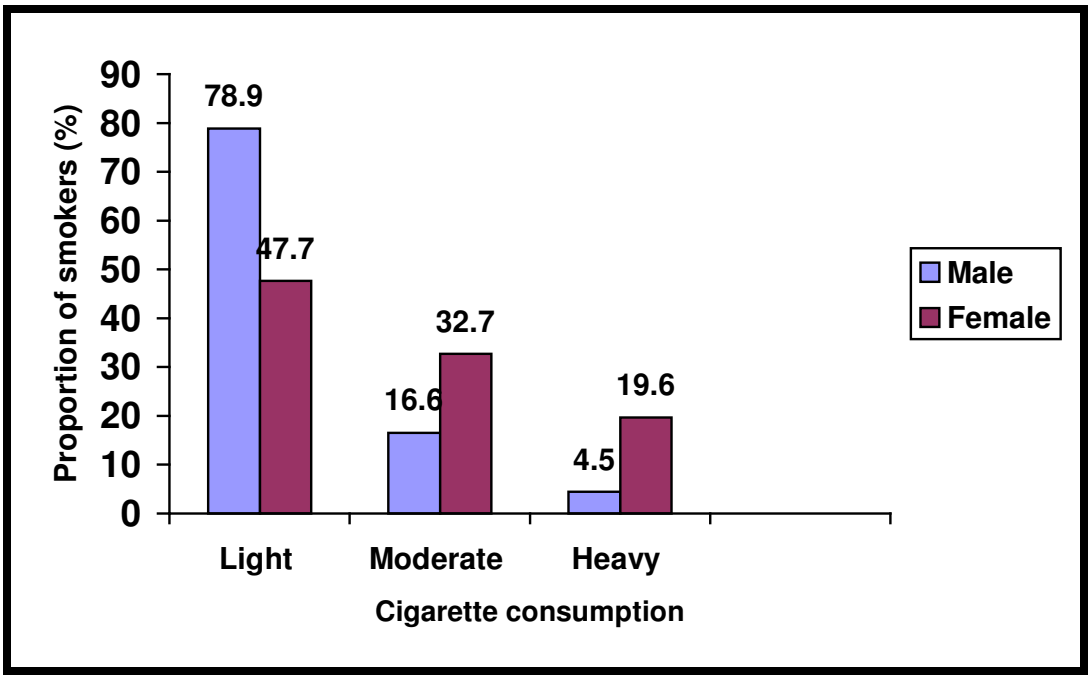


Figure 3.9: Cigarette consumption by gender

3.3.4 Cigarette consumption, job grade and race

Mine employees in job grade D smoked more cigarettes on a daily basis than those in other job grades. Mine employees in job grade D smoked on average, 15 cigarettes per day compared to those in job grades A and B who smoked 5. The difference in mean number of cigarettes smoked was significant by job grade ($p<0.001$). Job grades A and B, which are predominantly black, had a relatively higher proportion of light smokers than job grades C and D, which are predominantly white. However, the proportion of moderate smokers increased steadily from 7.2% in job grade A to 54.2% in job grade D and there was a significant difference in the distribution of mine employees by job grade in the various categories. Stratifying by job grade and race, blacks in job grade B had the highest proportion of smokers in all consumption categories (greater than 80%) followed by job grade A (7.7% –11.2%). The other job grades had negligible proportions of smokers (less than 2.7%) as seen in figure 3.10. However the distribution of smokers by smoking consumption and job grade was only significant for blacks ($p = 0.02$). For whites, the distribution showed no difference by cigarette consumption and job grade, with highest prevalence of all consumption categories in job grade C ($p = 0.282$) as shown in figure 3.11.

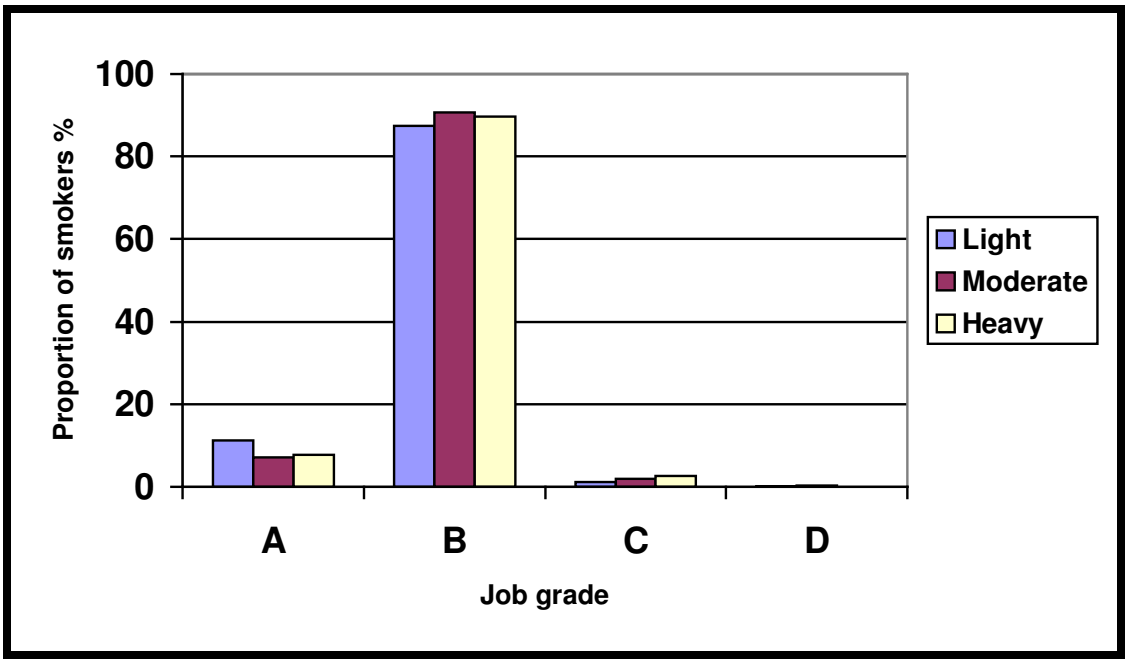


Figure 3.10: Distribution by job grade and cigarette consumption: Black mine employees

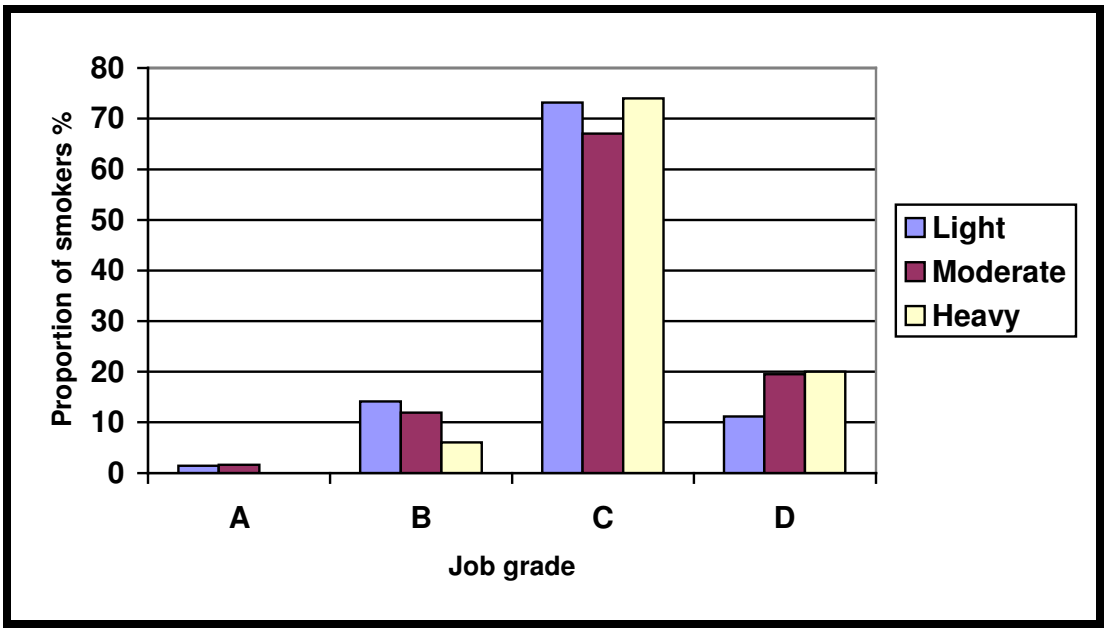


Figure 3.11: Distribution by job grade and cigarette consumption: White mine employees

3.4 Trend analysis

Table 3.4 shows the trend in demographic characteristics of the mine employees from 1998 to 2002. The population of mine employees varied between 14371 and 17103 from 1998 to 2002. On average, there was a male to female ratio of 98:2 throughout the period. The age distribution of mine employees during each year of study was relatively normal with mean and median ages varying between 40 to 41 years and 40 to 42 years respectively. The age of mine employees ranged between 16 and 66 throughout the study. By age group, the distribution of employees remained relatively consistent throughout the five-year period with the highest proportion of mine employees aged 35 to 44 years (44.8% to 48.2%). By job grade, the proportion of employees also remained relatively consistent throughout the five-year period with the highest proportion of mine employees in job grade B (61.3% to 67.5%). Job grade D had very few people (<1%). The ratio of black to whites was consistent from 1998 to 2001 (around 12:1) then decreased in 2002 to 9:1.

Table 3.4: Demographic characteristics of platinum mine employees from 1998 - 2002

Characteristic	FREQUENCY BY YEAR				
	1998 n(%) n = 14371	1999 n(%) n =16816	2000 n(%) n =17103	2001 n(%) n =15759	2002 n(%) n = 16744
Gender Male	14215 (98.9)	16575 (98.6)	16869 (98.6)	15506 (98.4)	16381 (97.8)
Female	156 (1.1)	241 (1.4)	234 (1.4)	253 (1.6)	361 (2.2)
Age group					
< 25	618 (4.3)	933 (5.6)	1019 (6.0)	1140 (7.2)	1633 (9.8)
25 – 34	3091(21.5)	3698 (22.0)	3773 (22.1)	2532 (22.4)	4043 (24.2)
35 – 44	6933 (48.2)	7953 (47.3)	8094 (47.3)	7356 (46.7)	7504 (44.8)
45 – 54	3190 (22.2)	3597 (21.4)	3608 (21.1)	3303 (21.0)	3250 (19.4)
55 – 66	539 (3.8)	635 (3.8)	609 (3.6)	428 (2.7)	314 (1.9)
Job grade A	1007 (7.0)	1211 (7.2)	1251 (7.3)	1231 (7.8)	1299 (7.8)
B	8807 (61.3)	10423 (61.9)	10897 (63.7)	10641 (67.5)	10704 (63.9)
C	471 (3.3)	474 (2.8)	514 (3.0)	415 (2.6)	402 (2.4)
D	129 (0.9)	116 (0.7)	124 (0.7)	90 (0.6)	82 (0.5)
Unknown	3957 (27.5)	4592 (27.3)	4317 (25.2)	3382 (21.5)	4257 (25.4)
Race					
Black	13238 (92.1)	15603 (92.8)	15828 (92.5)	14602 (92.7)	15110 (90.2)
White	1133 (7.9)	1213 (7.2)	1275 (7.5)	1157 (7.3)	1634 (9.8)

Each year, employees smoked, on average, 8 cigarettes per day, ranging from 7.2 to 8.2 with no obvious trend. Some mine employees smoked as few as 1 cigarette and others as many as 60 cigarettes per day.

Overall, smoking prevalence decreased from 43.3% in 1998 to 31.3 % in 2002 (table 3.5). This was a significant downward trend ($p<0.001$). Among smokers, the proportion of light smokers increased from 59.9% to 64.7% and a corresponding decrease in the proportion of heavy smokers from 12.1% to 9.8% with no obvious trend.

Table 3.5: Smoking status and cigarette consumption of platinum mine employees from 1998 - 2002

Characteristic	FREQUENCY BY YEAR				
	1998 n(%) n = 14371	1999 n(%) n =16816	2000 n(%) n =17103	2001 n(%) n =15759	2002 n(%) n = 16744
Smoking status					
Smoker	6215 (43.3)	6838 (40.7)	5609 (32.8)	4886 (31.0)	5236 (31.3)
Non smoker	8156 (56.7)	9978 (59.3)	11494 (67.2)	10873 (69.0)	11506 (68.7)
Cigarette Consumption					
Light	3722 (59.9)	4472 (65.4)	3475 (62.0)	3316 (67.9)	3389 (64.7)
Moderate	1739 (28.0)	1648 (24.1)	1583 (28.2)	1138 (23.3)	1333 (25.5)
Heavy	754 (12.1)	718 (10.5)	551 (9.8)	432 (8.8)	514 (9.8)

3.4.1 Trends in smoking prevalence by race

There was a significant downward trend in smoking prevalence from 1998 to 2002 for blacks and whites ($p<0.001$ and $p=0.035$ respectively) as shown in figure 3.12.

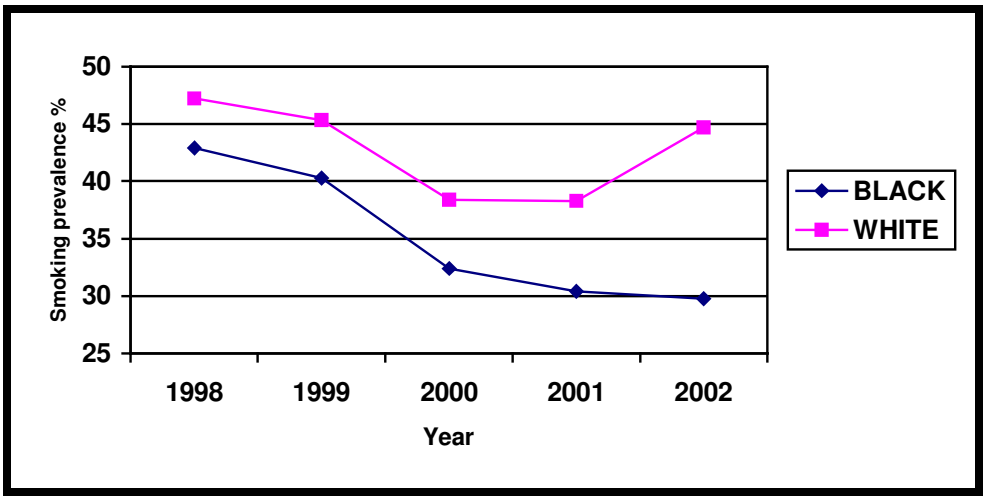


Figure 3.12: Smoking prevalence by race (1998 – 2002)

3.4.2 Trends in smoking prevalence by job grade and race

Overall, there was a significant downward trend in smoking prevalence for all job grades from 1998 to 2002 ($p<0.001$) except for job grade D ($p = 0.355$). However, Job grade D had very few smokers, which makes it difficult to detect a trend in this job grade; hence Job grade D was excluded from any further trend analyses.

When analysed by race, however, there were significant downward trends for blacks in job grades A and B ($p<0.001$) but a weak downward trend for blacks in job grade C ($p = 0.058$) as shown in figure 3.13. For whites, a significant downward trend was found for those in job grade C ($P=0.003$); however the upward trends for those in job grades A ($p=0.06$) and B ($p=0.40$) were not statistically significant (figure 3.14). It is worth noting that there were a small number of whites in job grade A (<7) none of whom smoked from 1998 to 2000.

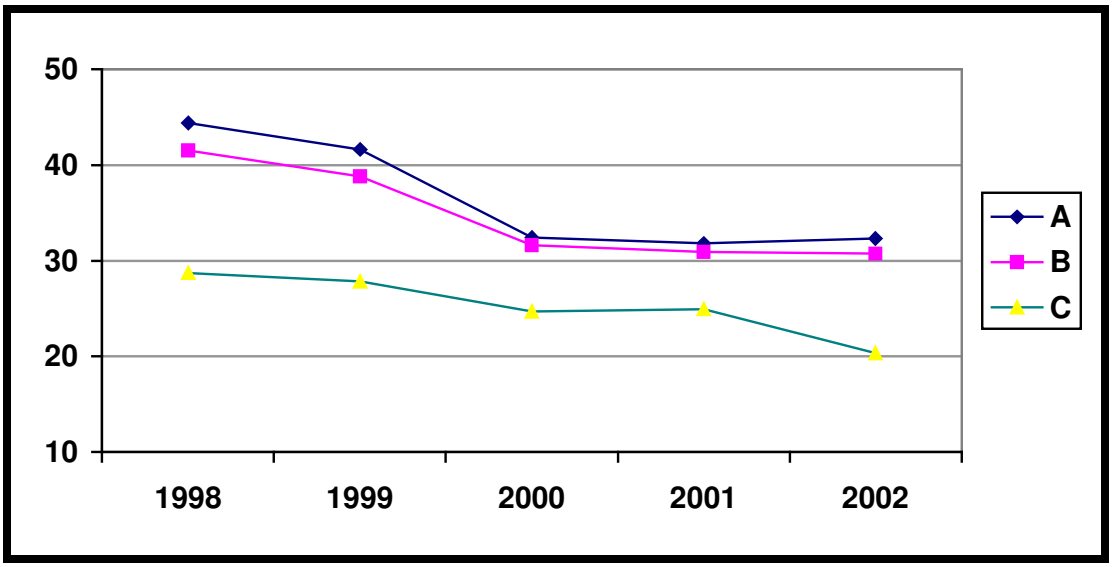


Figure 3.13: Smoking prevalence by job grade from 1998 - 2002: Black mine employees

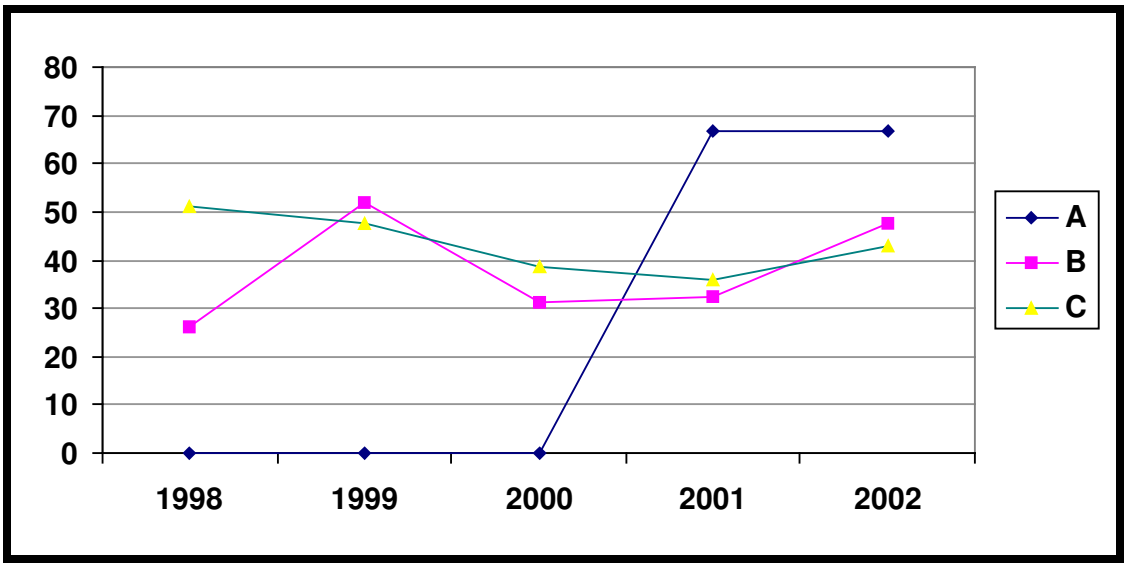


Figure 3.14: Smoking prevalence by job grade from 1998 - 2002:White mine employees

3.4.3 Trends in smoking prevalence by age group and race

When analyzed by race there was a downward trend in smoking prevalence for black mine employees in all age groups ($p<0.001$) as shown in figure 3.15. No such trend was seen for white mine employees (figure 3.16).

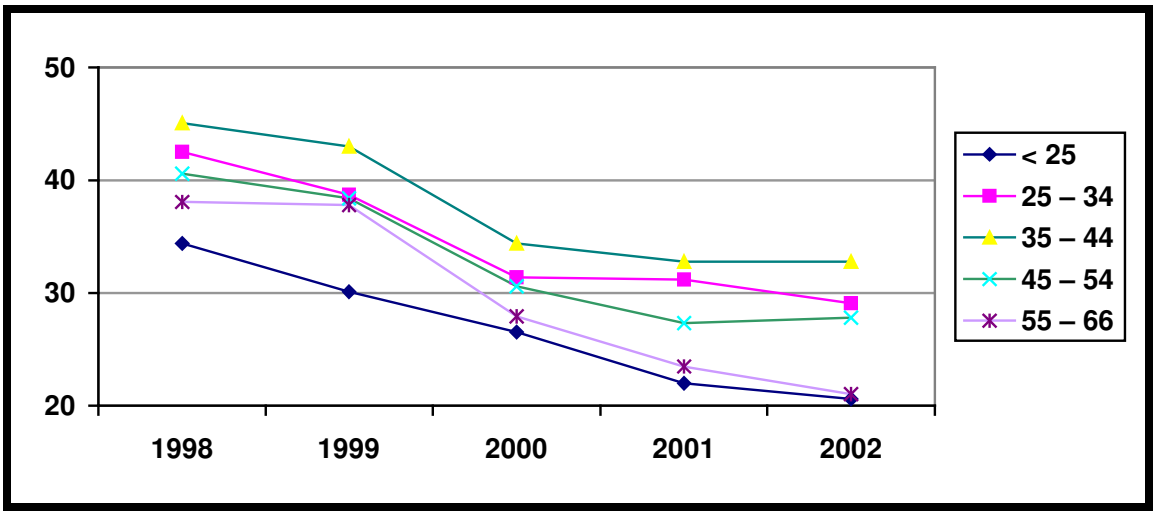


Figure 3.15: Smoking prevalence by age group from 1998 - 2002:Black mine employees

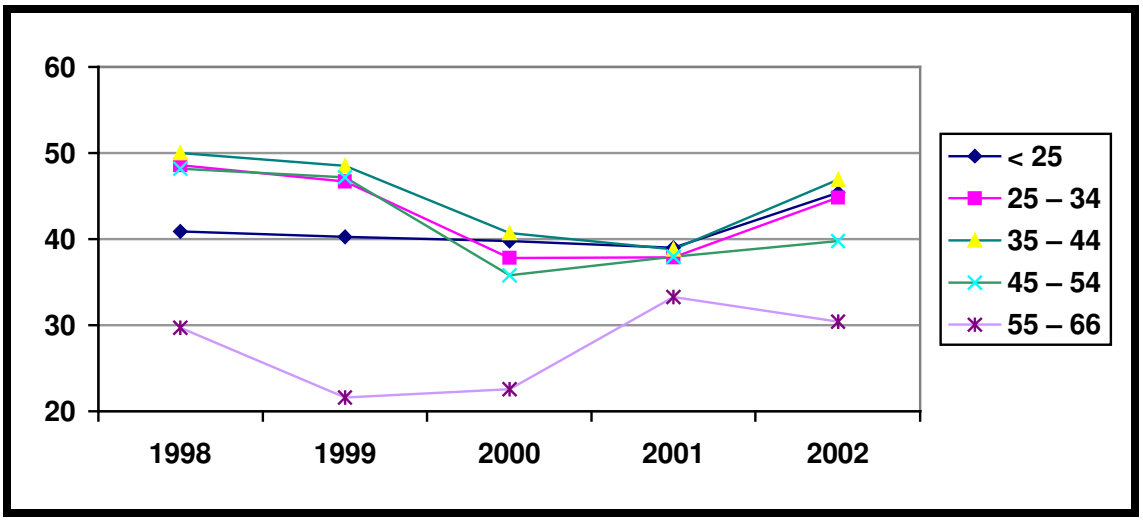


Figure 3.16: Smoking prevalence by age group from 1998-2002:White mine employees

3.4.4 Trends in cigarette consumption by race

Figure 3.17 shows the distribution of the proportions of blacks in each category of cigarette consumption. There was an upward trend in light smoking among blacks and a corresponding downward trend in moderate and heavy consumption. In figure 3.18, the trend was also upward for white light and moderate smokers and a corresponding downward trend for heavy white smokers.

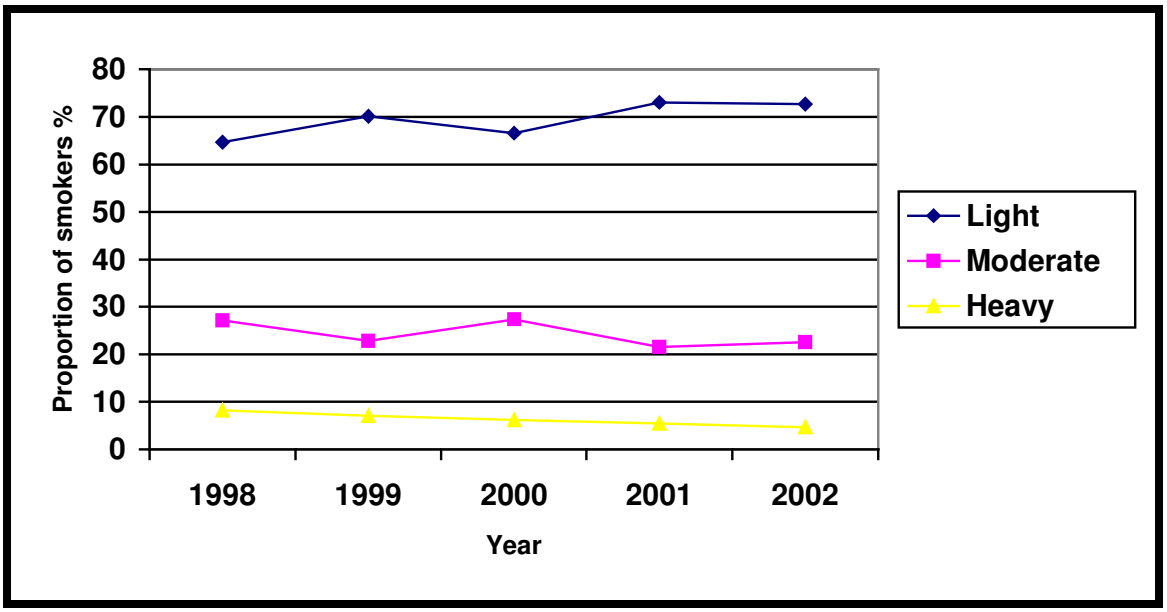


Figure 3.17: Trend in cigarette consumption from 1998 - 2002: Black smokers

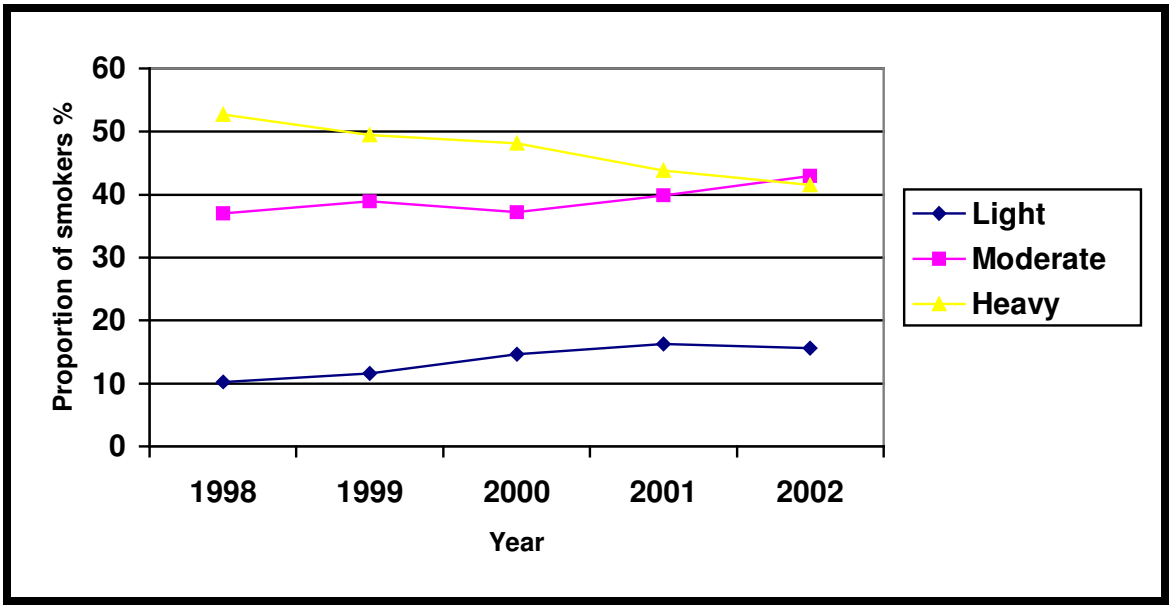


Figure 3.18: Trend in cigarette consumption from 1998 - 2002: White smokers

3.4.5 Trends in cigarette consumption and job grade

The majority of smokers in grades A and B were light smokers. The consumption in these two grades did not change much between 1998 and 2002 (figures 3.19 and 3.20). Grade C overall had fewer light smokers than grades A and B, with the majority of smokers in grade C being heavy smokers; again there was no obvious pattern over time (figure 3.21).

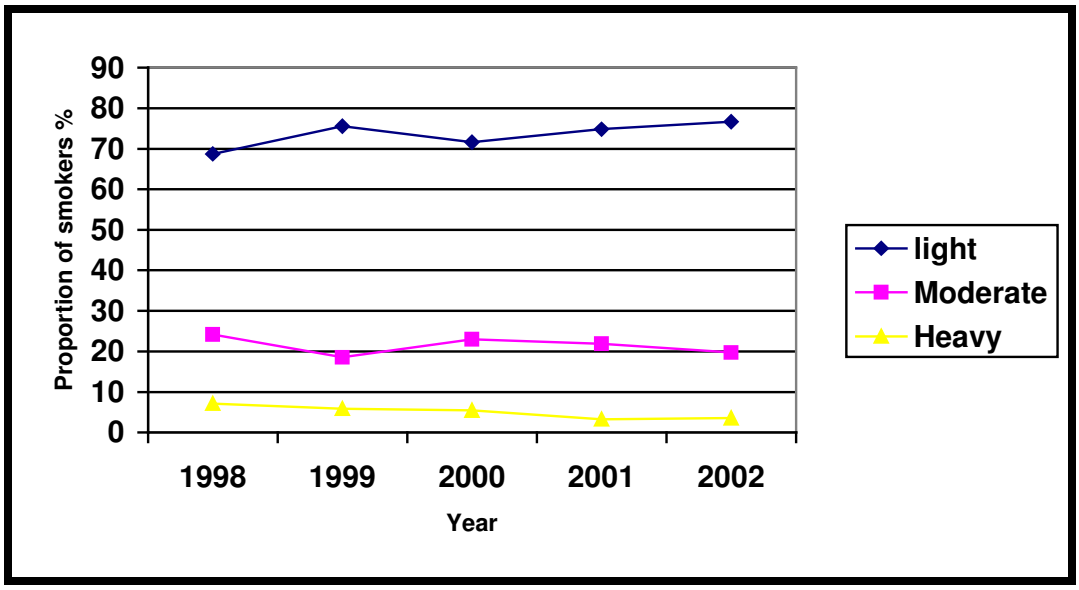


Figure 3.19: Trend in cigarette consumption by job grade from 1998 – 2002: Grade A

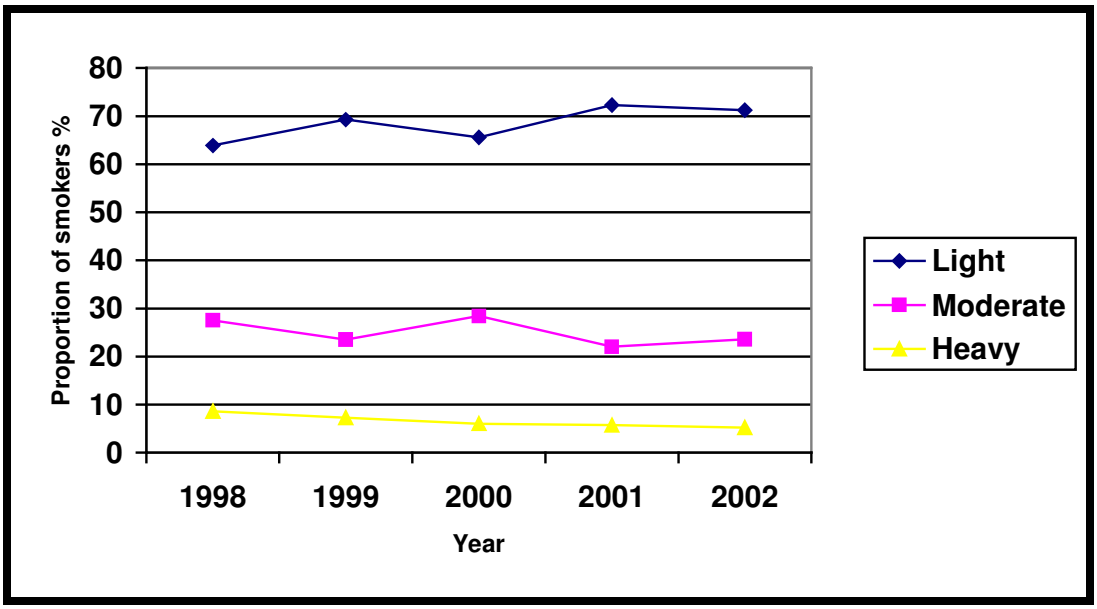


Figure 3.20: Trend in smoking consumption by job grade from 1998 – 2002: Grade B

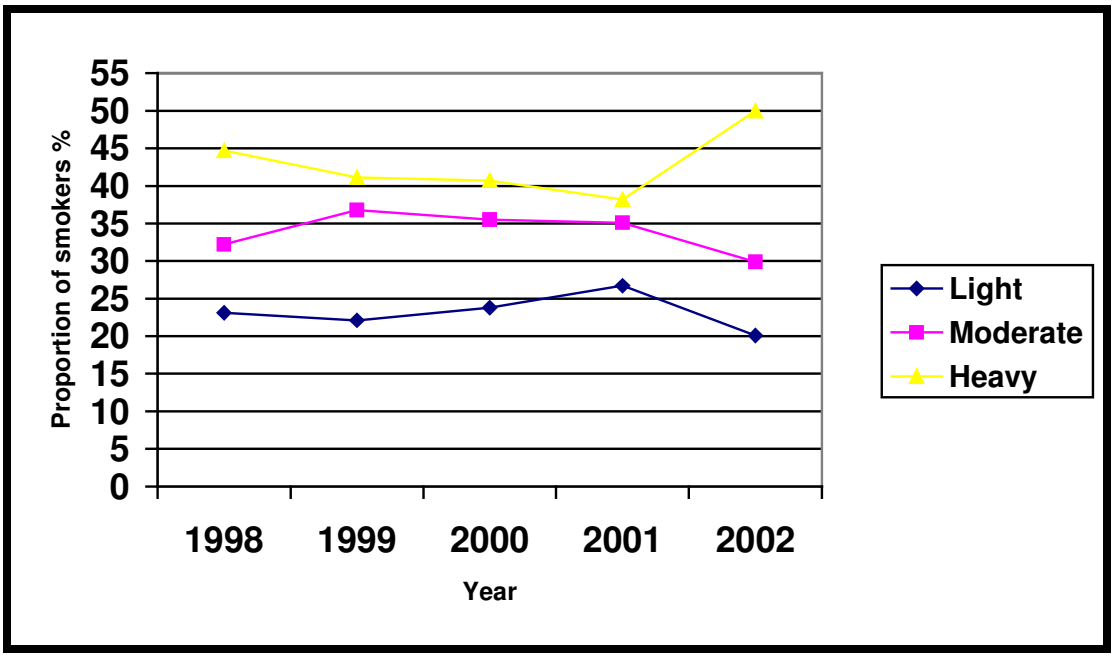


Figure 3.21: Trend in smoking consumption by job grade from 1998 – 2002: Grade C

3.5 Multivariable Analysis

3.5.1 Ever smokers

An aggregated analysis using multiple logistic regression analysis was carried out to investigate factors associated with subjects ever smoking over the entire five-year period (i.e. a subject was regarded as “ever smoking” if he/she smoked in at least one year). In which case there was an assumption of independent observation as one record was analysed per subject. The analysis results are summarized in table 3.6. In this analysis, when one factor is considered, the odds ratios (ORs) are adjusted for all other factors. The model showed that the adjusted odds for smoking decreased with job grade when job grade A was considered as baseline (reference). Employees in job grade B were less likely to ever smoke than those in job grade A (OR = 0.83, CI = 0.75 – 0.93). The ORs decreased further for job grades C and D. Whites were 2.5 times more likely to ever smoke than blacks (OR = 2.5, CI 1.98 – 3.27). Females were much less likely to smoke than males (OR=0.21, CI 0.15 – 0.30). The OR for ever smoking was highest for the age group 35 – 44 years, using the age group 25 years and younger as the baseline. Employees older than 54 years were no more likely to smoke than those younger than 25.

Table 3.6: Adjusted Odds ratio for "ever smoking" with associated factors

Factor	Adjusted odds ratio for ever smoking	P-value	Confidence interval (CI)
Job grade A	1.00	-	Reference
B	0.83	0.001	0.75 – 0.93
C	0.50	< 0.001	0.40 – 0.65
D	0.27	< 0.001	0.19 – 0.39
Gender Male	1.00	-	Reference
Female	0.21	< 0.001	0.15 – 0.30
Race Blacks	1.00	-	Reference
Whites	2.50	< 0.001	1.98 – 3.27
Age group < 25	1.00	-	Reference
25-34	1.40	< 0.001	1.18 – 1.66
35-44	1.60	< 0.001	1.35 –1.88
45-54	1.31	0.002	1.11 – 1.56
55-66	1.00	0.966	0.71 – 1.38

3.5.2 Always smokers

A second multiple logistic regression analysis was carried out to investigate factors associated with subjects who smoked over the entire five-year (always smokers). The results are summarized in table 3.7. Again, when one factor was considered, the odds ratios (ORs) were adjusted for all other factors. The model showed that there was no increase in the OR for job grade B, compared to job grade A but the OR decreased for job grades C and D. Females were less likely to smoke than males (OR = 0.3, CI 0.18 – 0.49). Whites were 2.4 times more likely to smoke than blacks (CI 1.79 – 3.20). Employees aged 35-44 years were the most likely to smoke compared to those younger than 25 years.

Table 3.7: Adjusted Odds ratio for "always smoking" with associated factors

Factor	Adjusted odds ratio for always smoking	P-value	Confidence interval (CI)
Job grade A	1.00	-	Reference
B	1.00	0.967	0.87 – 1.14
C	0.92	0.581	0.69 – 1.24
D	0.56	0.012	0.36 – 0.88
Gender Male	1.00	-	Reference
Female	0.30	< 0.001	0.18 – 0.49
Race Blacks	1.00	-	Reference
Whites	2.40	< 0.001	1.79 – 3.20
Age group < 25	1.00	-	Reference
25-34	1.37	0.006	1.10 – 1.72
35-44	1.48	< 0.001	1.19 – 1.84
45-54	1.17	0.183	0.93 – 1.46
55-66	0.55	0.029	0.33 – 0.94

3.5.3 Trend in smoking

The trend in smoking over time was examined by fitting a mixed model for longitudinal data (i.e. using the profiles of smoking for each subject) since the observations for a given worker in successive years are not independent. This method uses all of the available observations, e.g. if one subject is not present in all years. The models have become the accepted standard for repeated measures data. The results are summarized in Table 3.8. Note that job grade was not included in the model due to the extremely unbalanced nature of the factors in that there is a very strong association between race and job-category - in particular there were very few whites in job grades A and B. It was decided not to fit both job category and race in the same model as it would be very difficult to

disentangle the effects. After adjusting for gender, race and age group there was overwhelming evidence that smoking decreased over time, with a drop in 1999 and a further drop in 2000, after which it seemed to level out.

Table 3.8: Smoking trend by associated factors over the five years period

Factor	Adjusted odds ratio for smoking	P-value	Confidence interval (CI)
Gender Male	1.00	-	Reference
Female	0.10	< 0.001	0.07 – 0.14
Race Blacks	1.00	-	Reference
Whites	1.76	< 0.001	1.55 – 1.99
Age group < 25	1.00	-	Reference
25-34	1.51	< 0.001	1.27 – 1.77
35-44	1.73	< 0.001	1.48 – 2.03
45-54	1.51	< 0.001	1.28 – 1.78
55-66	1.10	0.648	0.82 – 1.37
Year 1998	1.00	-	Reference
1999	0.71	< 0.001	0.64 – 0.78
2000	0.25	< 0.001	0.23 – 0.28
2001	0.22	< 0.001	0.20 – 0.24
2002	0.23	< 0.001	0.21 – 0.25

3.5.4 Cigarette consumption

Another mixed model for longitudinal data was fitted to find factors affecting the number of cigarettes smoked, given that the individual was an ever smoker, and in particular to investigate whether there was a trend in the number of cigarettes smoked over time, given that the individual was an ever smoker"

The results are summarized in Table 3.9. There was a decrease in cigarette consumption over time (adjusting for the effect of job grade, gender, race and age group), with a greater decrease in 2001 and 2002.

Table 3.9: Relationship between number of cigarettes smoked and associated factors

Factor	Coefficient	P-value	Confidence interval (CI)
Job grade A	**0**	**-**	**Reference**
B	-0.16	<0.001	-0.23 to -0.08
C	0.06	<0.001	-0.15 to 0.26
D	-0.90	<0.001	-1.31 to –0.50
Gender Male	0	-	Reference
Female	-1.73	<0.001	-2.67 to –0.79
Race Blacks	0	-	Reference
Whites	9.58	<0.001	9.32 to 9.84
Age group < 25	0	-	Reference
25-34	1.54	<0.001	1.18 –1.90
35-44	2.10	<0.001	1.75 – 2.44
45-54	2.17	<0.001	1.80 – 2.54
55-66	1.55	<0.001	0.99 – 2.12
Year 1998	0	-	Reference
1999	-0.53	<0.001	-0.67 to – 0.40
2000	-0.39	<0.001	-0.53 to – 0.25
2001	-0.93	<0.001	-1.08 to – 0.78
2002	-0.96	<0.001	-1.10 to – 0.81

Chapter 4

4.0 Discussions and Conclusion

4.1 Introduction

Smoking has become an important public health issue in the mines firstly because its effects may be potentiated by other occupational exposures[18] and secondly because there is a tendency for people in labour oriented industries, like the mines, to smoke more than those in professional and people oriented services[12].

4.2 Changes in smoking prevalences

4.2.1 Changes in overall prevalence

Around one quarter of employees were smokers throughout the study (always smokers) and 44.4% smoked at sometime during the study (ever smokers). There was a significant overall decrease in smoking prevalence from 43.3% in 1998 to 31.5% in 2002. This was in line with the trend, reported nationally, of a significant reduction in national smoking prevalence[10]. Another study in South Africa by the Economics of tobacco control project[12], also reported reductions in the prevalence of smoking.

Tobacco control advocates came together in 1994 to form the Tobacco Control commission for Africa to build a capacity to stimulate and develop resources to sustain tobacco control initiatives[7] and this could have played a part in the continued decreasing risk and prevalence of smoking during the study. Since miners cannot smoke underground, new recruits may smoke less due to the fact

that they spend most of their time in a new environment, viz. underground. Some older miners may get discouraged to smoke as a result of frequent interruptions. Either way there may be a tendency to quit or reduce the number of cigarettes smoked. The decrease in smoking prevalence may also be a sign that WHO recommendations[48] may be beneficial in tobacco control as they seem to be accomplishing their goals. It may also be attributed to the anti smoking legislation, increased excise imposed on the price of cigarettes (average retail price of cigarette per pack has increased from R4.97 in 1997 to more than R10 in 2002[49]) and greater public awareness of the health impacts of cigarette smoking[11,50,51]. Reddy et al.[11] reported that health warnings create a desire to cut down or quit cigarette smoking.

Another factor that may have contributed to the decrease in smoking prevalence in this study is the possible underreporting by junior workers, as they may fear disciplinary action, in addition to the fact that acceptability of smoking has reduced. It is worth noting that smoking status was self-reported.

4.2.2 Changes in prevalence by demographic groups

It has been reported that race, gender, age and education play a significant role in people's smoking status[11]. It has also been reported that demographic groups that have experienced most reduction are blacks, poor people and males[50].

Whites were 2.5 times more likely to ever smoke than blacks during the entire period of this study. In 1998 smoking prevalence in whites, was 47.2%; in blacks it was 42.9%. Prevalence decreased for both blacks and whites until 2000, with significant differences between whites and blacks for each year throughout the study. By 2000, smoking prevalences among black and white miners had dropped to 32.4% and 38.4%, respectively, compared to national prevalences of 22.7% and 32% for blacks and whites, respectively[12]. In 2002, the prevalence of smoking increased in whites, to 44.7%, but continued to decline to 29.8% in blacks.

This significant difference in race prevalence suggests that the tobacco industry has not been successful in penetrating the black market[12] but black smokers may be influenced by other factors, e.g. price.

Overall, the average age of smokers in the platinum mine was around 38.2 years throughout the study period, ranging from 16 to 66 years. Employees aged 35-44 years were more likely to ever smoke than those younger than 25 (OR 1.6, CI 1.35 – 1.88).

The smoking prevalence by age group was more than 10% higher for white platinum mine employees younger than 25 than the national smoking prevalence for young adults aged 16 – 24 years (There was a prevalence of 29.8% in whites compared to 18.7%[12]). White platinum mine employees older than 54 had the lowest smoking prevalence for ever-smokers.

This higher white prevalence may well be a result of better buying power as youths with higher incomes smoke more than those with lower incomes[51]. On the other hand, the lowest smoking prevalence among whites older than 54 may be a result of lifestyle/health consciousness at this age especially for the more affluent groups of the society who are more likely to seek medical support due to poorer health[51].

The lowest smoking prevalence for blacks who ever smoked was in those younger than 25 and those older than 54. Blacks in the middle age group of 35 – 54 years had the highest prevalence of ever smokers. Black employees in all age groups had a significant downward trend in smoking prevalence from the beginning to the end of the study.

The relative low prevalence in black employees younger than 25 may be due to the fact that acceptability of smoking has reduced and they have not yet developed the addictive habit of smoking. Alternatively, it may mean that blacks only start smoking after joining the mine and this could provide an educational

opportunity for preventing smoking. The black downward trend in prevalence in all age groups could be because blacks are more responsive to price increases than whites. Most blacks earn less than whites as there are more blacks in the lower wage grades. Smoking prevalence is generally lower for blacks and low earning power in the absence of anti-smoking campaigns accentuates this[52].

With job grade used as a proxy for education and socio-economic status, the findings were in line with other studies that found smoking prevalence to be higher among people with primary and secondary education than people with tertiary education[13]. In this study too, higher job grades had a lower prevalence of ever smokers (87.8% for blacks in grade B, compared to 0.1% for blacks in grade D; and 70.1% for whites in grade C, compared to 18.1% for whites in grade D). Over the study period the smoking prevalence trend was downward for blacks in grades A and B and for whites in Grade C. However, employees in grade B were less likely to ever smoke than those in grade A (OR = 0.83, CI = 0.75 – 0.93).

Job grade D constitutes lower managerial and senior management with a small number of subjects who are predominantly white so this may explain the black lower prevalence of 0.1%. Another reason may be attributed to the fact that white managers are older and more likely to smoke because there was greater acceptability of smoking when they were younger. Black managers are younger and smoking acceptability had reduced when they were younger.

It has also been reported that workers who are exposed to occupational health hazards have the highest smoking prevalence[12]. This supports the fact that those in lower job grades like miners and labourers, i.e. job grades A and B, had a higher prevalence of 10.8% and 87.8%, respectively.

4.3 Changes in cigarette consumption

It is not surprising that the decline in smoking prevalence over the study period coincided with a decline in cigarette consumption (the prevalence of light smokers increased from 59.9% in 1998 to 64.7% in 2002, and heavy smokers decreased from 12.1% in 1998 to 9.8% in 2002). This supports the relationship between prevalence of smoking and intensity of smoking. On average, whites smoked more than blacks (1.76 cigarettes per day when adjusted for other factors; 9 cigarettes per day when unadjusted). This finding is similar to the national statistics on race and smoking status[12]. More blacks were light smokers while more whites were moderate and heavy smokers. Most heavy and moderate smokers of both races were aged 35 – 44 years.

An unexpected finding was that among the women who smoked, most were heavy smokers and the proportion was higher than those of males. However, there were few women (n=107) in the study and the results must be interpreted in the light of this. Cigarette consumption was higher in job grades D. For blacks there were higher proportions of moderate and heavy smokers in grade B and

higher proportions of these for whites in grade C. This finding supports the hypothesis that employees in higher grades have better buying power.

4.4 New smokers

Only 4.8% of employees started smoking during the study. Few employees of both races started smoking during the study (4% whites and 5% blacks). Blacks in the middle age group of 35 – 54 years had the highest prevalence of new smokers (43.7%). The highest prevalence in whites was in employees younger than 25 (42.6%) and could be a result of peer pressure. However, the prevalence of new smokers in employees older than 54 was very low (1.6% in whites and 4% in blacks) which could be a result of health consciousness, and/or the development of smoking related diseases, leading to quitting or early retirement due to health reasons. The highest prevalences of new smokers were in the lower job grades (87.6% for blacks in grades B and 66.7% for whites in grade C). This could be as a result that low grade workers have less access to information on the health implications of smoking but it also contradicts the earning power theory.

4.5 Ex-smokers

During the study, 18.4% of employees gave up smoking. More black employees (44.8%) gave up smoking compared to white employees (19.2%). Chaloupka and Pacula[51] also reported that young blacks were more responsive to price than are

young whites and this could be because of the lesser strength of addiction in blacks and reduced peer pressure.

There was a higher prevalence of ex-smokers in blacks and whites aged 35 – 54 years. Even though blacks in the middle age group of 35 – 54 also had the highest prevalence of new smokers, the proportion of ex-smokers was higher which was in line with other studies that reported a reduced smoking initiation among youths and increased cessation and relapse among adults[51], and so this group should also be a target for smoking cessation programmes. The highest prevalences of ex-smokers were also in the lower job grades (51.6% for blacks and 36.3% for whites). This could be due to cost. However, this is unexpected as other studies support the hypothesis that decline in adult smoking occurred among the more affluent population [53].

4.6 Limitations of the study

- The results are not generalisable to the mining industry since the study was conducted in one platinum mining group.
- Missing information – There was some unavailable information for some variables, (especially for job grades). There were 9540 (37.7%) unknown job grades. This would reduce the power of the study with respect to analysis using job grades.
- Reporting bias – Number of cigarettes smoked per day was self-reported. There is a tendency that these miners' reports may underestimate use especially in lower grade workers who may fear disciplinary action.
- Healthy Worker effect – Sick smokers may have left the mine thus giving a lower prevalence than would have been calculated if they were still employed.
- It is difficult to determine whether the smoking prevalence and consumption declines refer to miners who have stopped smoking or new recruits who are non-smokers as analysis did not follow up individuals over the period of study.

4.7 Conclusions

Smoking will continue to be a topical health issue since the burden of disease that it poses on populations and the economy is very high. The effect of smoking on miners is of great importance because of its interaction with occupational exposures such as silica dust, diesel fumes noise and radon. Thus, it is important

to monitor and reduce the prevalence of smoking in the mining industry, utilizing relevant policy and training guidelines. Since detailed and comprehensive smoking information and good data quality from surveillance programmes are relatively scarce and inconsistent, efforts must be directed towards routine collection and analysis of relevant smoking data in order to keep abreast of the health problem. Investment in smoking cessation and prevention programmes is advisable to assist workers to reduce or quit smoking. This will contribute to the reduction of smoking-related diseases as part of health promotion among miners. Such programmes could alleviate some costs incurred through compensation of these smoking related diseases. Emphasis of such programmes must be directed at specific risk groups, viz. blacks in job grades A and B (high smoking prevalence), whites in job grades C and D (high smoking prevalence and high cigarette consumption), and blacks younger than 25 (low smoking prevalence and perhaps who have not started smoking and hence are a target for prevention).

4.8 Recommendations

- Generally, there is need to scale up tobacco control strategies that are working, viz smoking restrictions, consumer education campaigns and smoking cessation therapies[54].
- There is a need to collect smoking data during routine surveillance programmes on all mines.

- Detailed smoking information should be collected during surveillance, e.g. past smoking status, when smoking started and when smoking stopped. This information will be useful in evaluating the effectiveness of control measures.
- More frequent data analysis should be performed to identify target groups, e.g. those with low smoking prevalence, low consumption, high smoking prevalence and high consumption, for appropriate intervention programmes, viz. prevention versus cessation.
- Prevention and active cessation programmes, including posters, warning signs and training sessions should be set up to address risk groups to emphasize these hazards.
- Focused counseling towards active cessation and nicotine replacement therapies should be encouraged.
- Routine interventions, incorporating health hazards of smoking, should be established. Such programmes could include educational interventions during yearly medical surveillance that incorporate the health hazards of smoking and its interactive effects with other occupational exposures in causing diseases in miners, and available information on the prevalence of some smoking associated diseases in miners. These should also be incorporated in the training plan as a continuous reminder.

- Further research should be conducted on smoking status, hearing impairment, knowledge of health effects and attitudes towards tobacco control in South African mining industry.
- Further qualitative research should be conducted to address why miners smoke, in order to develop cessation programmes focused on these difficulties.
- National or mine specific alliances with the MRC and the Council against Smoking should be established for resources and current up-to-date information.

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