RESEARCH PAPER

South African platinum mine employees reduce smoking in 5 years

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Background: South Africa adopted comprehensive tobacco control policies in the 1990s. Smoking has since declined in the general population, but there is little information on the effect of the campaign in labour-intensive industries, especially the mining industry where workers are exposed to dust, which may interact with tobacco smoke to cause respiratory disease.

Objectives: To determine the prevalence of, and trends in, smoking in employees of a South African platinum mining company, from 1998 to 2002, and to describe some demographic factors associated with their smoking habits.

Methods: This study used smoking data collected during annual fitness-to-work medical examinations. Employees were categorised into never, ever, continuous, new and ex-smokers. Data were analysed by race and age group. Age-standardised smoking prevalence rates were compared with rates in the South African general population.

Results: There were 80 713 records of 25 274 mine employees for the 5-year period. The decrease in smoking prevalence over this period was significant in both black and white men, but was greater in the former (from 42.9% to 29.8%, and from 47.2% to 44.7%, respectively). In 2002, the prevalence of smoking in black mine employees was 12.1% lower than that in black men in the general population. The prevalence of smoking decreased in black mine employees in all age groups ($p < 0.001$); no such trend was seen for white mine employees. The proportion of light smokers increased significantly from 59.9% to 64.7%, with a corresponding significant decrease in the proportion of moderate and heavy smokers from 28.0% to 25.4%, and from 12.1% to 9.8%, respectively.

Conclusion: This study showed a significant decrease in smoking prevalence over a relatively short period, despite the fact that there was no smoking cessation programme in the company. The decline can be largely attributed to the South African government's antismoking initiative and supports the drive to continue to increase excise taxes on cigarette products. Nevertheless, the relatively high prevalence of smoking in some groups of mine employees highlights the need for workplaces to support the government's initiatives to curb smoking by establishing smoking cessation and prevention programmes.

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The Tobacco Products Control Act (Act 83 of 1993) was promulgated in South Africa at the beginning of 1994,¹ with the main thrust being printed health warnings on tobacco product packaging. Although excise taxes began to increase slightly from 1991, the significant change came in the same year that the Act was promulgated when excise tax on cigarettes was increased to 50% of the retail price.² As a result, the nominal excise tax more than quadrupled from 1993 to 2001. The prevalence of smoking in the general South African population decreased from 32.6% in 1993 (51.4% in males and 12.9% in females) to 28.5% in 1998.³ In 1999, the Act was amended (the Tobacco Products Control Amendment Act, Act 12 of 1999) to what is considered to be one of the most progressive tobacco control legislations worldwide¹ and included restrictions on smoking in enclosed public places and a ban on tobacco advertising. Smoking prevalence in the general population continued to drop to 27.1% in 2000 but was still high among males (43.8%, compared with 11.7% among females).³ The most significant decreases were detected among males, black people, young adults and low-income households.³

People in labour-intensive jobs, such as mining, tend to smoke more than those employed in more sedentary jobs.⁴ The Economics of Tobacco Control Project reported an overall prevalence of smoking in the mining sector as 43.5% in 2000.⁴ In 1997, Kleinschmidt⁵ found that white miners were more likely to smoke than black miners (odds ratio = 2.98). In South Africa, data on race are still collected to identify and eliminate

population disparities. Churchyard *et al*⁶ reported a prevalence of 37% among black gold miners aged >40 years for the same year. A higher proportion of white gold miners reportedly smoked (86%) in the earlier years.⁷

Smoking potentiates the effect of dust on respiratory impairment^{8–9} and miners who smoke are thus at a higher risk than the general population of developing chronic obstructive pulmonary disease,^{10–11} pulmonary tuberculosis,^{11–12} lung cancer^{13–15} and hearing loss.¹⁶ Hnizdo⁸ estimated that the attributable fractions for severe airflow obstruction were 8% for dust alone, 42% for smoking and 40% for the combined effect of silica dust and smoking. These diseases also place an economic burden on the mines as South African miners with these diseases are eligible for compensation,¹⁷ regardless of smoking history.

The objectives of this study were to determine the prevalence of smoking and cigarette consumption in platinum mine employees from 1998 to 2002, to describe smoking and cigarette consumption trends, and to identify some sociodemographic factors associated with smoking.

METHODS

In terms of South African legislation,¹⁸ all miners undergo regular medical screening examinations that include a physical examination, a chest radiograph and lung function testing. One

Abbreviation: AMPS, All Media and Products Survey

Table 1 Demographic characteristics of platinum mine employees, 1998–2002

	Year					
	Overall, n (%) [*]	1998, n (%)	1999, n (%)	2000, n (%)	2001, n (%)	2002, n (%)
Total	25 274 (100)	14 371 (100)	16 816 (100)	17 103 (100)	= 15 759 (100)	16 744 (100)
Gender						
Male	24 606 (97.4)	14 215 (98.9)	16 575 (98.6)	16 869 (98.6)	15 506 (98.4)	16 381 (97.8)
Female	666 (2.6)	156 (1.1)	241 (1.4)	234 (1.4)	253 (1.6)	361 (2.2)
Unknown	2 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.0)
Age group (years)						
<25	2604 (10.3)	618 (4.3)	933 (5.5)	1019 (6.0)	1140 (7.2)	1633 (9.8)
25–34	5996 (23.7)	3091 (21.5)	3698 (22.0)	3773 (22.1)	2532 (16.1)	4043 (24.1)
35–44	10 927 (43.2)	6933 (48.2)	7953 (47.3)	8094 (47.3)	7356 (46.7)	7504 (44.8)
45–54	4897 (19.4)	3190 (22.2)	3597 (21.4)	3608 (21.1)	3303 (21.0)	3250 (19.4)
55–66	850 (3.4)	539 (3.8)	635 (3.8)	609 (3.6)	428 (2.7)	314 (1.9)
Income group						
Low	14 750 (93.7)	9814 (94.2)	11 634 (95.2)	12 148 (95.0)	11 872 (95.9)	12 003 (96.1)
Middle	772 (4.9)	471 (4.5)	474 (3.9)	514 (4.0)	415 (3.4)	402 (3.2)
High	212 (1.3)	129 (1.2)	116 (0.9)	124 (1.0)	90 (0.7)	82 (0.7)
Unknown	9540 (–)	3957 (–)	4592 (–)	4317 (–)	3382 (–)	4257 (–)
Race						
Black	22 120 (87.5)	13 238 (92.1)	15 603 (92.8)	15 828 (92.5)	14 602 (92.7)	15 110 (90.2)
White	3154 (12.5)	1133 (7.9)	1213 (7.2)	1275 (7.5)	1157 (7.3)	1634 (9.8)

^{*}The total number of employees for whom there was at least one routine medical examination record in the period 1998 to 2002.

of the large South African platinum mining companies concurrently collects additional information on smoking. These smoking data were analysed for employees who underwent annual medical examinations from 1998 to 2002, using Epi-Info 2002 and STATA V.7.

Employees were already categorised into income groups on the database. Low-income employees were primarily underground miners who were paid, on average, R3000 per month (US \$420) in 2001. Those in the middle-income group were mainly artisans, whereas the high-income group comprised management staff (average monthly wages in 2001 were R9800 (US \$1360) and R10 500 (US \$1460), respectively).

Smoking was self-reported and was defined as never (those who did not smoke at all throughout the study period), continuous (those who smoked throughout the study period), new smokers (those who started smoking during the study period), ex-smokers (those who quit smoking during the study period) and ever smokers (a combination of continuous, ex- and new smokers). Smoking consumption categories were defined by the number of cigarettes smoked per day as light (<10), moderate (10–19) and heavy (≥20). Smoking prevalence and cigarette consumption were calculated for each year of the study. Trend analyses were performed for smoking prevalence. Differences in mean cigarette consumption were calculated by race and age group. Proportions were compared using χ^2 tests.

The trends in smoking prevalence were also compared with those in the general population. Figures for the general population were obtained from the All Media and Products Survey (AMPS) database, which has been described elsewhere.³ These data are collected consistently, on an annual basis. The same questions are asked in each survey, providing meaningful data trends. The smoking prevalence rates for the mine employees were age standardised to the South African general population data for 2001.¹⁹ Ethics approval for this study was obtained from the University of the Witwatersrand Human Research Ethics Committee, Johannesburg, South Africa (ethics clearance number M03-08-10).

RESULTS

Demographic characteristics

In total, 25 274 platinum mine employees had routine medical examinations from 1998 to 2002 (table 1), with a total of

80 713 records. Each year, >90% of the employees were examined; the number ranged from 14 371 to 17 103. Most employees were male (97.4%). Black workers comprised 87.5% of the study population. The mean age each year was around 40 years, with a range of 16–66 years. The distribution by age group remained relatively consistent in those aged >34 years, with the highest proportion in the age group 35–44 years in all years (44.8–48.2%). The percentage of employees aged <25 years more than doubled from 4.3% in 1998 to 9.8% in 2002. Over the same period, there was an increase of 30% in employees aged <35 years.

Information on income group was unavailable for 37.7% of the study population (32.1% of black employees and 76.2% of white employees). Most of the black employees for whom data on income group were available were in the low-income group (97.9%), whereas most of the white employees for whom data on income group were available were in the middle and high-income groups (76.5%). Due to the large amount of missing data, smoking prevalences and cigarette consumption were not analysed by income group.

Smoking prevalence

Over the period, 43.9% of black workers were in the ever smoked category compared with 47.8% of white workers. Because this difference was significant ($p = 0.005$), all analyses were performed independently for black and white men. As shown in table 2, >50% of the study population did not smoke throughout the study period (never smokers). Most black employees aged <25 years never smoked (72.9%), compared with 53.9% of white employees. More people gave up smoking (19.7% of black men and 9.2% of white men) than those who started (5% of black men and 4% of white men). A higher proportion of black than white employees were ex-smokers across all age groups; up to twofold in some age groups. The proportion of ex-smokers was lowest in black and white men aged <25 years. More white than black employees were smokers throughout the study period (35.4% and 21.3%, respectively).

Cigarette consumption

Most black men were light smokers (87.2%), whereas most white men were moderate smokers (48.6%). This trend was

Table 2 Smoking status of platinum mine employees by race and age group

Race, age group (years)	N	Smoking status				
		Never smokers, n (%)	Continuous smokers, n (%)	Ever smokers, n (%)	New smokers, n (%)*	Ex-smokers, n (%)*
		14 046 (100)	5831 (100)	11 228 (100)	1217 (100)	4645 (100)
Black						
<25	1629	1188 (72.9)	245 (15.0)	441 (27.1)	93 (5.7)	130 (8.0)
25–34	5108	2996 (58.7)	1097 (21.5)	2112 (41.3)	250 (4.9)	859 (16.8)
35–44	10 101	5263 (52.1)	2350 (23.3)	4838 (47.9)	479 (4.7)	2218 (22.0)
45–54	4496	2499 (55.6)	861 (19.2)	1997 (44.4)	229 (5.1)	1005 (22.4)
55–66	786	453 (57.6)	163 (20.7)	333 (42.4)	44 (5.6)	143 (18.2)
Total	22 120	12 399 (56.1)	4716 (21.3)	9721 (43.9)	1095 (5.0)	4355 (19.7)
White						
<25	975	526 (53.9)	365 (37.4)	449 (46.1)	52 (5.3)	40 (4.1)
25–34	888	456 (51.4)	322 (36.3)	432 (48.6)	34 (3.8)	83 (9.3)
35–44	826	403 (48.8)	304 (36.8)	423 (51.2)	27 (3.3)	95 (11.5)
45–54	401	214 (53.4)	117 (29.2)	187 (46.6)	7 (1.7)	65 (16.2)
55–66	64	48 (75.0)	7 (10.9)	16 (25.0)	2 (3.1)	7 (10.9)
Total	3154	1647 (52.2)	1115 (35.4)	1507 (47.8)	122 (3.9)	290 (9.2)

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

apparent across all age groups (table 3). The differences between white and black men were significant for all consumption categories ($p<0.001$). White employees, on average, smoked 14 cigarettes per day compared with black employees who smoked five ($p=0.000$).

Trends in smoking prevalence

At the start of this study, in 1998, the age-standardised prevalence of smoking in the black platinum mine employees (39.6%) was lower than the AMPS reported national figure of 46.2%, whereas for the white employees, the rate (44.3%) was slightly higher than the national figure of 43.1% (table 4).

From 1998 to 2002, smoking prevalence in black platinum mine employees decreased by 34.1% (from 39.6% to 26.1%, $p<0.001$); in white platinum mine employees, the decrease was much smaller but still significant (4.3%; from 44.3% to 42.4%, $p<0.001$). By 2002, the prevalence of smoking in black mine employees was 12.1% lower than that in black men in the general population. However, the smoking prevalence among white mine employees was very similar to that of white men in the general population (44.4% and 42.2%, respectively). There was a downward trend in smoking prevalence for black mine

employees from 1998 to 2002 in all age groups ($p<0.001$) but no such trend was seen for white mine employees.

Trends in cigarette consumption

Figure 1 shows the changing proportions of black and white men in each cigarette consumption category over the study period. There was an upward trend in the light consumption category among black men and a corresponding downward trend in moderate and heavy consumption. The trend was also upward for white men in the light and moderate consumption categories, with a corresponding downward trend in the heavy consumption category. Overall, the proportion of light smokers increased significantly from 59.9% to 64.7%, with a corresponding statistically significant decrease in the proportion of moderate and heavy smokers from 28.0% to 25.4%, and from 12.1% to 9.8%, respectively. There were no obvious trends in smoking consumption by age group over time for any of the consumption categories.

DISCUSSION

Despite the fact that there was no company smoking cessation programme on the mine at the time of the study, a large

Table 3 Cigarette consumption in platinum mine employees by race and age group

Race, age group (years)	Cigarette consumption category			Total
	Light (<10), n (%)	Moderate (10–19), n (%)	Heavy (≥ 20), n (%)	n
Black				
<25	400 (90.7)	36 (8.2)	5 (1.1)	441
25–34	1899 (89.9)	199 (9.4)	14 (0.7)	2112
35–44	4182 (86.4)	612 (12.6)	44 (0.9)	4838
45–54	1710 (85.6)	265 (13.3)	22 (1.1)	1997
55–66	287 (86.2)	35 (10.5)	11 (3.3)	333
Total	8478 (87.2)	1147 (11.8)	96 (1.0)	9721
White				
<25	159 (35.4)	208 (46.3)	82 (18.3)	449
25–34	93 (21.5)	197 (45.6)	142 (32.9)	432
35–44	73 (17.3)	219 (51.8)	131 (31.0)	423
45–54	26 (13.9)	99 (52.9)	62 (33.2)	187
55–66	3 (18.8)	10 (62.5)	3 (18.8)	16
Total	354 (23.5)	733 (48.6)	420 (27.9)	1507

Table 4 Comparison of trends in smoking prevalence in the South African National population and platinum mine employees, by race, 1998–2002

Year	Black men			White men		
	General population*	Data of mine employees		General population*	Data of mine employees	
		Crude	Standardised†		Crude	Standardised†
1998	46.2	42.9	39.6	43.1	47.2	44.3
1999	44.6	40.3	36.3	43.1	45.3	42.1
2000	42.3	32.4	29.9	39.5	38.4	36.3
2001	37.9	30.4	27.2	39.0	38.3	37.7
2002	38.2	29.8	26.1	42.2	44.7	42.4

*Source: AMPS data.

†Standardised to 2001 general population.¹⁹

number of smokers quit (45% of black and 19% of white mine employees). There was a 17.3% reduction in the prevalence of smoking in black men in the general population over the 5-year period but the decrease was much greater among the black mine employees (34.1%). Consequently, in 2002, significantly fewer black mine employees smoked than did the black males in the general population. The reduction in smoking prevalence among the white mine employees was much smaller than that for the black employees. The reduction among the white employees was marginally greater than that for the white men in the general population. In 2002, the smoking prevalence among the white mine employees was the same as that of the white men in the general population. Along with the reduction in smoking prevalence, there was also a decline in cigarette consumption over the study period. Overall, the proportion of light smokers increased whereas the proportion of moderate and heavy smokers decreased.

The decrease in smoking prevalence among the employees may be partly attributable to the South African antismoking legislation and an increased awareness of the health impacts of cigarette smoking. The legislation restricted smoking in public places, raised the age limit for buying tobacco products and banned tobacco advertising. However, as mentioned, the increased cost of cigarettes over the study period could have been the most important factor in encouraging people to quit smoking. From 1997 to 2002, the average retail (nominal) price of cigarettes increased by >100%; inflation increased by an average of around 32% over the same period.²⁰ Increasing the price of tobacco products has been reported to be a highly effective method of reducing both prevalence and consumption,^{2, 21} particularly among lower socioeconomic groups.²²

The study population comprised mainly black men in the low-income group who were likely to have been more responsive to price increases than the primarily white, higher earners. Smoking prevalence has been shown to be lower for

those with low earning power, even in the absence of antismoking campaigns.^{3, 23} The difference in the decline in smoking between black and white men is probably directly related to increased prices. The differential rate of decline between black and white miners may also be explained partly by the observation that black workers smoked an average of five cigarettes a day compared with 14 for white workers. Those who smoke less are generally more successful in quitting than those who smoke more.²⁴ Demographic changes may partly explain the decline in smoking in the workforce. The proportion of young mine employees increased over the study period and, as younger miners are generally less likely to smoke than older miners,³ this could have affected the measured prevalence and consumption rates.

The age-standardised smoking prevalences of the platinum mine employees were compared with smoking prevalences obtained from the AMPS data. These data are obtained from a sample of households across the country, and are weighted to represent the adult South African population.²⁵ The results from this study may not be directly comparable with the AMPS data as the adult South African population includes people in the lowest earning sectors, and those who are unemployed. The reduction in smoking among the platinum mine employees was greater than that of the general population over the same period. This could be due to the inclusion, in the AMPS database, of wealthy people who retire early and who may, to some extent, dilute the overall reported effect of increased tobacco prices.

One of the limitations of the study is that smoking status and consumption were self-reported and no tests, such as urinary cotinine, were carried out to confirm these reports. As smoking is becoming unacceptable, some smokers could have reported that they did not smoke, resulting in an underestimate of the prevalence of smoking in the mining population. A further limitation was the lack of data on income group classification for 38% of the study population. Consequently, it was not possible to analyse the data by income. However, there was a strong correlation between income group and population group as, historically, black men in South Africa were, and are still, in many instances, employed in lower income jobs than white men. The black workers in this study were therefore taken to represent low-income earners, whereas the white workers represented middle- and high-income earners.

This study shows that a fairly rapid decrease in cigarette smoking can be achieved in a short period of time, and without a major effort by employers. Many of the study subjects either reduced their smoking consumption or quit altogether. We ascribe this mainly to the government's tobacco control policies and the consequent increases in the price of cigarettes.

Smoking is responsible for around 8% of adult deaths in South Africa,²⁶ and remains a problem in miners due to the additive adverse effects of smoking and dust on respiratory health, as well as noise-induced hearing loss. The effects of smoking are costly to

Figure 1 Trends in cigarette consumption in platinum mine employees by race, 1998–2002.

What this paper adds

- Cigarette smoking is well known to potentiate occupational exposures such as silica dust and asbestos in causing respiratory disease in miners.
- The South Africa government embarked on an intensive antismoking campaign in the 1990s and, although some information is available on subsequent smoking trends in the general population, almost nothing is known about smoking prevalence and patterns in high-risk occupations such as mining.
- The study confirms that national policies can have important local effects. An industry with employees at a high risk of tobacco-related disease benefited from general population-wide tobacco control measures.
- The prevalence of smoking in black mine employees is now lower than black men in the general population; the prevalence of smoking in white mine employees has decreased much more slowly and remains high.
- In conjunction with continuing increasing government-imposed excise taxes, there is a strong case for incorporating smoking cessation programmes in all workplaces.

the mines not only in terms of health but also financially. In 2005, compensation for silicosis, tuberculosis and occupational airways disease cost the mining industry more than R99 million (around US \$14 million; personal communication, Mr Nandlall, Department of Minerals and Energy, 2006) noise-induced hearing loss accounted for a further R135.8 million (around US \$19 million; personal communication, Dr A Begley, Rand Mutual Assurance Company, 2006).

Continuation of the South African government's antismoking initiatives will do much to further reduce the burden of smoking in the country. However, the effect may be more rapid if smoking programmes were incorporated into the already established medical screening and surveillance programmes in all workplaces. Although opportunities to smoke are already limited on the mines as smoking is prohibited underground for safety reasons, directed smoking cessation programmes at the workplace would supplement the Government's initiatives and be cost effective. The burden of disease would decrease with a corresponding reduction in compensation payments. Productivity would increase as the number of lost shifts due to illness, and the number of "smoke breaks", decreased.

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