OCCURRENCE AND CAUSES OF OCCUPATIONAL ASTHMA IN SOUTH AFRICA — RESULTS FROM SORDSA'S OCCUPATIONAL ASTHMA REGISTRY, 1997 - 1999

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Objective. To present results for the first 3 years of the occupational asthma registry of the Surveillance of Work-related and Occupational Respiratory Diseases in South Africa (SORDSA) programme, ending December 1999.

Design. Surveillance was accomplished by collecting voluntary reports of occupational asthma cases from pulmonologists, occupational medicine practitioners and occupational health nurses.

Setting. Medical and occupational health referral centres in the nine provinces of South Africa.

Subjects. Patients diagnosed with new-onset occupational asthma with latency or irritant-induced asthma, reported to SORDSA during 1997 - 1999.

Outcome measures. Frequencies of cases, causative agents, industries causing exposure and diagnostic methods. Average annual incidence rates by province and by occupation.

Results. During this period 324 cases of occupational asthma were reported. The average annual incidence rate of occupational asthma was estimated in the three best-reporting provinces, namely Gauteng, KwaZulu-Natal and the Western Cape, as 17.5 per million employed people annually. This rate was highest in the Western Cape (25.1 per million). Semi-skilled operators had the highest incidence rate of 68.7 per million annually in the three provinces. Isocyanates and latex were the most common agents. Low molecular weight causative agents predominated (68.8%) over high molecular weight agents. Health care was the most frequently reported workplace for occupational asthma (OA) development. Serial peak flow testing was the method most often used for diagnosis. One-fifth of the cases were still occupationally exposed to the causative agent at time of diagnosis.

Conclusion. Despite underreporting, SORDSA's estimate of the occupational asthma incidence rate was similar to that of the UK. SORDSA has also demonstrated that surveillance programmes in a developing country can provide useful information on which to base prevention activities.

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The extent and incidence of occupational asthma (OA) in South Africa is unknown, although it is the most commonly diagnosed occupational lung disease in developed countries according to results from surveillance registries in the UK,[1] Canada[2] and Finland.[3] Because over 200 occupational agents are known to cause OA,[4] and many affected workers leave the workplace, wide surveillance for OA is the best means of assessing the magnitude of the problem. This information can be used to facilitate and evaluate prevention programmes.

To obtain information on the extent of occupational respiratory disease in those employed in the non-mining sector, the nationwide Surveillance of Work-related and Occupational Respiratory Diseases in South Africa (SORDSA) was introduced in October 1996.[5] SORDSA provides the framework and infrastructure for a more detailed OA registry, which has been collecting data since October 1996. SORDSA's design was based on two existing surveillance systems, both of which have branches specifically for OA surveillance. In the USA, the Sentinel Event Notification System for Occupational Risks (SENSOR) has state-based surveillance programmes for work-related asthma,[6] and in the UK the SWORD project[7] (Surveillance of Work-related and Occupational Respiratory Diseases), and its branch, SHIELD,[8] in the West Midlands, survey newly diagnosed cases of OA.

The aim of this paper is to present results from SORDSA's occupational asthma registry obtained in the first 3 years (1997 - 1999).

METHOD

Occupational medicine practitioners, pulmonologists and occupational health nurses from the collaborating societies voluntarily reported newly diagnosed cases of occupational respiratory disease to SORDSA on prescribed monthly forms. For OA cases, additional, more detailed forms were completed. Apart from the putative causative agent, the industry in which the patient was exposed and the job the patient held, the additional information collected on the OA forms included the patient's initial history, methods and tests used in the diagnosis, and subsequent history. Both OA with latency, and irritant-induced asthma, known as reactive airways dysfunction syndrome (RADS), were accepted as OA cases.

Since underreporting of cases to SORDSA is potentially most problematic in six of South Africa's provinces, we have used only the three best-reporting provinces to estimate the average annual reported incidence of OA for comparison with rates estimated in other countries. Denominators were derived from the 1996 population census figures of employed economically active people per province and per occupation group.[9] Those employed in mining and quarrying were subtracted from the denominator figure since this sector of the workforce was not included in the surveillance. For patients' initial history, diagnostic methods and subsequent history, information was only available for 290 of the 324 OA cases reported, therefore a denominator of 290 was used for these proportions.

RESULTS

Until 1999, OA was the third most frequently reported occupational lung disease, following pneumoconiosis and inhalation accidents. In SORDSA's first 3 complete years, 1997 - 1999, 324 OA cases were reported nationally. These cases were predominantly male (68.8%, 223 cases), while 56 cases (17.3%) were female and in 45 cases (13.9%) the sex was unspecified.

Most cases of OA (307 cases, 94.8%) were reported from Gauteng, KwaZulu-Natal and the Western Cape. Table I shows the reported frequencies and average annual incidence rates of OA from these provinces. The average annual incidence rate of OA during the 3 years of reporting was 13.4 per million per year in Gauteng, 17.4 per million per year in KwaZulu-Natal and 25.1 per million per year in the Western Cape, with an average annual incidence rate of 17.5 per million in the three provinces.

In Table II the frequencies and average annual incidence rates of OA are shown by occupation group in the three provinces. Semi-skilled operators and production workers had the highest reported annual incidence rates. Skilled artisans and apprentices had the second highest incidence rates, except in the Western Cape where incidence rates for professional, semi-professional and technical workers were second highest. This group included health care professionals, many of whom were reported from a major hospital for latex-induced OA.

The agents reported to cause OA are shown in Table III. Isocyanates topped the list, causing 16.7% of the OA cases, followed by latex in 16.0% and flour and grain in 9.9%. Metals such as platinum salts, aluminium and vanadium were

Table I. Frequencies and annual incidence rates (IR)* of occupational asthma reported to SORDSA from three South African provinces (1997 - 1999)

Province	Occupational asthma with latency (*N*)	Irritant-induced asthma (*N*)	Total occupational asthma cases (1997 - 1999)	
			N	Average annual IR
Gauteng	74	22	96	13.4
KwaZulu-Natal	51	30	81	17.4
Western Cape	94	9	103	25.1
Total (3 provinces)	219	61	280	17.5

* Average annual incidence rate = annual incidence per million employed economically active population in that province.

Table II. Frequencies and average annual incidence rates (IR) of occupational asthma per million employed economically active people by occupation group in the three provinces as reported to SORDSA

Occupation group	Gauteng		KwaZulu-Natal		Western Cape		Total (3 provinces)	
	N	IR	*N*	IR	*N*	IR	*N*	IR
Professional, semi-professional and technical	14	10.5	3	4.3	43	64.5	60	22.2
Managerial, executive and administrative	2	5.2	3	20.4	2	8.9	7	9.2
Clerical, sales and service	4	2.6	1	1.4	4	6.0	9	3.0
Artisan, apprentice and related	33	26.8	19	34.0	26	55.4	78	34.5
Operator, production worker	28	53.1	36	101.0	15	56.4	79	68.7
Labourer and general worker	11	7.4	14	12.4	12	9.9	37	9.6
Unknown, other	4	3.9	5	5.2	1	2.5	10	4.2

Table III. Frequencies of agents causing occupational asthma cases reported to SORDSA

Agent	N	%
Isocyanates	54	16.7
Latex	52	16.0
Flour and grain	32	9.9
Platinum salts	29	9.0
Aluminium	19	5.9
Solder fumes/colophony	13	4.0
Other chemicals	10	3.1
Vanadium	8	2.5
Welding fumes	6	1.9
Glue and resin	6	1.9
Acrylates	5	1.5
Plastics	4	1.2
Paint	4	1.2
Chlorine	4	1.2
Formaldehyde	4	1.2
Brick dust	4	1.2
Chemical fumes	4	1.2
Laboratory animals	3	0.9
Other organic	3	0.9
Amines	3	0.9
Acids	3	0.9
Combination of chemicals and dust	3	0.9
Other/unspecified/ill-defined	49	15.2

Table IV. South African industries from which cases of occupational asthma were reported to SORDSA

Industry	N	%
Health care	53	16.4
Motor industry	27	8.3
Platinum refining	26	8.0
Aluminium smelting	20	6.2
Food	16	4.9
Building and roadworks	12	3.7
Foam and plastic	12	3.7
Baking	10	3.1
Grain milling	9	2.8
Paint industry	9	2.8
Welding	8	2.5
Chemical	7	2.2
Engineering	6	1.9
Textile	6	1.9
Leather	6	1.9
Education and research	5	1.6
Paper and pulp	5	1.6
Electronics	5	1.6
Railways	5	1.6
Resin	4	1.2
Agriculture	4	1.2
Printing	4	1.2
Animal feeds	4	1.2
Vanadium	4	1.2
Refrigeration	3	1.0
Unspecified/ill-defined	53	16.4

frequently reported. Overall, low molecular weight (LMW) agents were reported as the putative causative agent for OA in 68.8% of the cases, while high molecular weight (HMW) agents were reported in 28.7% of the cases. In 2.5% of cases, the specific cause of asthma was not identified.

The most frequently reported industries where exposure occurred are shown in Table IV. Health care (16.4%), followed by the motor industry (8.3%) and platinum refining (8.0%), were the most commonly reported workplace for OA development. The building and roadworks industry was identified in 3.7% of the cases. The causative agents reported from this industrial sector were mainly brick dust, followed by epoxy resin, silica, cement, chrome and sulphuric acid.

The proportion of SORDSA's OA cases attributed to allergic mechanisms was 65.5%. In total, 98.7% of the cases reportedly caused by HMW agents and 53.6% of the cases caused by LMW agents were attributed to allergic mechanisms. Overall, 26.6% of cases were attributed to irritant mechanisms. A smoking history was reported in 42.1% of cases, 11.1% had a previous asthma history and 88% were considered to have been exposed to a known OA cause.

Diagnostic tests used by practitioners are shown in Table V. With HMW agents, specific immunoglobulin E (IgE) testing was used most frequently (69.2%), followed by skin prick testing with specific allergens in 56.4% of the HMW cases. In the cases caused by LMW agents, 53.1% were diagnosed using serial measures of peak flow. Immunological tests were used less often in this group, although skin prick testing with common allergens was used in 33.6% of the LMW cases.

Table VI shows the patients' subsequent history at the time of reporting to SORDSA. Only 20% of cases were still exposed to the causative agent and working in the same job. One-third were in the same workplace, although no longer exposed. In 10% of cases the agent had been replaced or controlled and 16.2% of the patients had been retrenched or retired. Just over half the patients had been submitted for compensation for OA.

DISCUSSION

In South Africa, OA was the third most frequently reported occupational lung disease overall during the first 3 years of SORDSA's existence, whereas in some developed countries such as the UK it has consistently been the most commonly diagnosed occupational lung disease.[10] In South Africa, pneumoconiosis is still the most important occupational lung disease, partly because of the extensive mining population and poor dust control, although OA is becoming more widely recognised.

When compared with the incidence rate in other countries, estimated also from physician reporting surveillance schemes,

Table V. Tests used in the diagnosis of South African occupational asthma cases 1997 - 1999

% usage for method	% usage for HMW agents	% usage for LMW agents	Total % usage
Serial peak flow measurements	24.4	51.3	45.5
Specific IgE tests (RAST)	69.2	13.7	28.6
Skin prick tests (specific allergens)	56.4	17.1	27.6
Skin prick tests (common allergens)	25.6	33.6	31.7
Phadiatop	9.0	19.4	16.6
Total IgE measurements	1.3	16.1	12.1
Nonspecific bronchial challenge	3.8	17.1	13.4
Specific bronchial challenge	1.3	7.1	5.5

HMW = high molecular weight; LMW = low molecular weight; IgE = immunoglobulin E; RAST = radio-allergosorbent test.

Table VI. Subsequent history of occupational asthma patients reported to SORDSA

Subsequent history	% total
Still exposed	19.7
Same workplace, no longer exposed	33.4
Agent replaced or controlled	10.6
Changed job	7.3
Early retirement/retrenchment	16.2
Still under investigation	16.2
Applied for compensation	55.5

SORDSA's OA incidence rate is similar to that estimated for the UK by the SWORD national scheme at 19 per million annually.[11] This figure, like SORDSA's, was generated for the first 3 years of SWORD reporting, and in the subsequent year this figure rose to 37, indicating that there was also underreporting to SWORD during the first 3 years.[11] The SHIELD surveillance scheme for OA, which is concentrated over a much smaller area and population, ascertained a figure of 43 cases per million annually.[11] The OA incidence rates from the SENSOR project in the USA are similar to or lower than SORDSA's (18 per million annually in Michigan, 16 in Colorado, 8 in New Jersey and 3 in Massachusetts), but this scheme does not aim to estimate the total incidence, rather to identify potential sentinel cases which can be further investigated.[11] When capture-recapture methods were used in conjunction with knowledge of the overlap in the reporting sources to estimate the true incidence of OA in Michigan, the average annual rates were increased to between 58 and 204 cases per million per year.[12] The highest estimate of OA incidence of 175 per million was reported in Finland, detected through their national physician reporting scheme which is supported by law.[11] The variation in incidence rates between different countries is due to many factors, including compensation systems, legislation, and recognition by practitioners. SORDSA's approximation of the annual average incidence rate of OA is probably greatly underestimated, even though it is based on the three best-reporting provinces. There is still incomplete reporting in these provinces, and many cases are probably not being diagnosed as a result of lack of recognition and knowledge among workers and practitioners.

A principal difference between SORDSA and SHIELD is the reporting source. SORDSA only receives voluntary reports from physicians and occupational health nurses. In addition to voluntary reports by physicians, SHIELD receives reports from the Compensation Board.[13] In South Africa in 1997, 184 OA cases were reported to the Compensation Commissioner (Office of the Compensation Commissioner — personal communication), while 122 cases were reported to SORDSA during this period. Since only half of SORDSA's cases are submitted for compensation, there were over 100 cases reported to the Compensation Commissioner and not to SORDSA in 1997. If SORDSA could form a partnership with the Compensation Commissioner and receive information from claims, a more comprehensive picture of disease incidence could be gained. On the other hand, a potential advantage that SORDSA has over the other schemes is the participation by occupational health nurses in reporting. In the UK, patients who do not seek specialist care are not covered in the reporting since only specialists participate. However, while it would be helpful to know South Africa's true OA incidence, determining the extent of the problem and important industries and causative agents for the purposes of prevention are the primary goals of SORDSA.

Differences in the importance of the causative agents were expected in the surveillance schemes from South Africa, the UK and the USA, since the industrial processes in the countries differ. For example, OA caused by platinum salts in the platinum refineries was frequently reported to SORDSA, yet very rarely reported in the other countries. However, isocyanates have consistently been the most frequently reported agents to SWORD,[14] SHIELD[8] and SENSOR.[6] Active case finding activities by reporting doctors could also influence surveillance patterns that emerge.

Latex is an example of how surveillance systems can monitor trends in exposure over time. Until 1991, latex did not feature as an agent for OA in the UK as reported to SWORD. Since then it has increased in prominence following its recognition as a cause of OA, and it is now the fourth most reported agent for OA to SWORD.[15] Hopefully we will be able to witness such trends in decline of disease and exposure over the years.

For both SORDSA and SHIELD, serial peak flow testing was the most commonly used method of diagnosis. SHIELD physicians used serial peak flow testing in 50 - 72% of cases. Skin prick testing was not used as part of the diagnosis of OA by SHIELD physicians. Specific bronchial challenge testing was more frequently used by SHIELD's physicians (3 - 10%)[8] than by SORDSA's physicians. Overall, SORDSA's doctors used a wider variety of diagnostic tests than SHIELD's doctors, although serial peak flow measurements, specific IgE testing and specific bronchial challenge testing were possibly under-used by SORDSA doctors. However, in many cases serial peak flow testing is not appropriate, such as when a worker is no longer exposed, as was the case for most SORDSA patients at the time of diagnosis. Most of the cases in which specific IgE or radio-allergosorbent (RAST) testing was used were for HMW agent sensitisation, such as latex. Specific IgE testing may not be appropriate in many cases, such as when there is no commercially available antigen, or if the agent has a LMW, which was the case in two-thirds of SORDSA's OA cases. However, the most frequently reported LMW agents were isocyanates, for which commercially specific IgE tests are available. Sensitisation to platinum salts, the second most reported LMW agent, can be ascertained by skin prick tests, but the test is not commercially available.

SORDSA had a lower percentage of workers still exposed to the causative agent at the time of diagnosis (almost 20%) than SHIELD (28%)[8] or SENSOR (30.6%).[6] While this may seem to indicate that 80% of the affected patients had been removed from exposure by their employers, this is not necessarily true. Only one-third had been accommodated in the same workplace in a situation where they were no longer exposed. Nearly one-quarter of the OA patients reported to SORDSA had to leave their jobs, presumably because of their disease. This low percentage of workers still exposed at the time of diagnosis might also suggest that OA is detected and diagnosed later in South Africa compared with other countries, when the patients have already become too disabled to continue with their usual jobs.

Conclusion

SORDSA's estimation of the annual OA incidence rate in three provinces of South Africa, namely Gauteng, KwaZulu-Natal and the Western Cape, was 17.5 per million employed economically active people per year. This was similar to the OA rate reported for the first 3 years of surveillance in the UK, yet lower than in most other developed countries. SORDSA's results probably underestimated true OA incidence in South Africa, owing to different reporting sources, insufficient reporting coverage, lack of supporting legislation, inefficient compensation systems which discourage affected workers from applying for compensation, and lack of awareness of diagnosis and causes. However, the results have shown that OA surveillance in South Africa can be useful in identifying exposures and industries where further investigation is necessary for prevention purposes.

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