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Marikana platinum mine workers' autopsies

Occupational injuries in a large paper mill in South Africa

... use of mosquito nets and indoor residual spraying with insecticide

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From the Editor . . .

Andrew Swanepoel, Editor

In this fourth issue of 2014, we feature two papers, highlighting serious but preventable public health issues affecting the workforce, as well as a reflection on the fatal miners' 2012 strike at Marikana.

In our ever-increasing and highly developed electronic communication systems, paper remains an essential product. The worldwide demand for paper compels pulp and paper manufacturing companies to continually increase their outputs.[1] Dlamini and colleagues describe the types and causes of occupational injuries in a large paper mill in South Africa. In addition to determining the prevalence of occupational injuries in this relatively under-researched industry, they point to some key recommendations that are intended to expedite the promotion of an injury-free culture within the mill.

Malaria is a formidable public health problem. In 2012, there were around 207 million cases with an estimated 627 000 deaths globally, mostly among African children. Simultaneously, global malaria mortality rates have reduced by 42%, with a 49% decline in the WHO African Region.[2] One country that has achieved remarkable results in the fight against malaria is Bhutan in South Asia, where confirmed malaria cases declined by 98.7% from 1994 to 2010.[2] Malaria-endemic countries have been prompted to shift their focus from prevention to elimination. As part of country-level efforts, researchers have tested several approaches to alleviate the burden of malaria. One such effort is highlighted in a sophisticated analysis by Ayele et al., using the Ethiopian baseline household cluster malaria survey.

A major public health challenge is the prevention and management of imported malaria cases. The geographic specificity of malaria makes foreign and migrant workers particularly vulnerable. Apart from the mobility of workers to malaria endemic areas, the poor environmental conditions (e.g. damp and shabby conditions) in which workers find themselves, further heightens their risk. The Chinese Center for Disease Control and Prevention, for example, reports that provinces where more labourers had moved to other countries for work had seen extremely serious cases of malaria.[3]

The August 2012 Marikana massacre, in which 34 platinum mine workers were shot and killed by police, attracted huge national and international attention. It also presented researchers at the National Institute for Occupational Health (NIOH) with an opportunity to gain insight into the health of currently employed platinum mine workers. Based on the results of forensic autopsies, Phillips and colleagues discuss the problem of high silicosis rates and pulmonary tuberculosis, against the background of cross recruitment within the mining industry. They highlight issues of the contract labour system and migrancy which add to the health, social and economic problems of platinum (and other) mine workers. This topical paper is a timeous contribution, especially as we await the much anticipated outcome of the Farlam Commission of Enquiry into this tragedy.

The five-month long strike in the mining industry has marked a sad and tumultuous time in the history of South African mining. Notwithstanding the loss of income to miners and their families, the strike will have far-reaching consequences for occupational health, including interrupted antiretroviral and tuberculosis treatments, annual medical surveillance disruptions, and resulting failed medical examinations. Other health and social consequences include stress, exhaustion, and poor working relationships. The strike has resulted in compromised health and well-being of the mining workforce, the long-term consequences of which remain to be seen.

Another inevitable consequence of the prolonged strike is the retrenchment of scores of mine workers. Drastic measures, such as job terminations and complete mine shut downs are already underway. The sad reality is that occupational health departments in the mining sector often suffer the greatest losses as a result of resource reallocation, resulting in a knock-on effect on the already compromised health of the mining workforce. In spite of a resolution finally being reached, there were certainly no winners in this strike!

We are delighted to welcome PathCare as a new partner. We thank Ampath for their previous support and look forward to PathCare's contributions going forward. Be sure to read the interesting article from Dr Essack and colleagues on arsenic in this issue.

The International Commission on Occupational Health (ICOH) is now advertising its 31st Congress from 31 May to 5 June 2015 in Seoul, Korea. The theme of "Global Harmony for Occupational Health: Bridge the World" will provide an exciting opportunity to share, debate and discuss a range of occupational health issues. The deadline for abstract submission – 31 August 2014 – is fast approaching. We encourage you to submit abstracts of your research.

In a joint commitment to worker health, the World Organization of Family Doctors (WONCA) and the ICOH issued a joint statement on workers' health on 27 June 2014, forming a good basis for the cooperation between the two organizations. The full statement is available at: http://www.icohweb.org/site_new/ico_homepage.asp

SASOHN held its annual academic days in Johannesburg (hosted by the Vaal Region), and Cape Town (hosted by the Western Cape Region). The theme "The wind in your sails – management for OHNPs" centred around management concerns of the OHNPs including, among other topics, work-life balance, retirement management, change management, and time management.

We are very pleased to feature the SASOM Scientific Guidelines in this issue. Please read through them and take advantage of SASOM's offer to provide more information. We congratulate the SASOM experts with different specialisations and interests for their hard work and dedication in ensuring that we remain at the cutting edge of information.

Once again, we encourage you to send us your research papers, and any relevant information on occupational health that you think other readers would like to hear about. Winter seems to be slowly but steadily making its exit. As we prepare to usher in Spring, I wish you fresh, blossoming and bright new ideas.

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Upcoming events

LOCAL MEETINGS

DATE	MEETING	TOPIC	PLACE	MORE INFORMATION
3-6 Sep 2014	10th PHASA Conference	Dignity, rights and quality: towards a healthcare revolution	Protea Ranch Resort, Polokwane, Limpopo	E-mail: deon.salomo@mrc.ac.za Website: www.phasaconference.org.za/
5-6 Sep 2014	MMPA Annual Congress		Kloofzicht Lodge 5, Kromdraai Road, Muldersdrift, Johannesburg	E-mail: elaineg@mpas.org.za
9-11 Sep 2014	4th Global Health and Safety Forum in Mining	Health and Safety in Mining	Hyatt Regency Hotel, Rosebank, Johannesburg	E-mail: Sanjay.Swamy@ flemminggulf.com Website: http://energy.flemminggulf.com/global-hs-forum-in-mining
18-21 Sep 2014	South African Society of Travel Medicine Congress	Travel Health Africa – Quo Vadis?	Elangeni Hotel, Durban	Website: http://www.sastm.org.za/
21-24 Oct 2014	12th International Mesothelioma Interest Group Conference	The ongoing quest for cure	Cape Town International Conference Centre	E-mail: jimtewn@mweb.co.za Website: http://imig2014.org/
29-31 Oct 2014	SAIOH Annual Conference	Beyond dust and noise	North-West University, Potchefstroom Campus	E-mail: Johan.DuPlessis@nwu.ac.za Website: http://www.saioh.co.za/Conference2014.aspx
4-6 Nov 2014	3rd Annual Junior Mining and Exploration Conference & Exhibition	Unlocking the Potential for Growth	The Forum, The Campus, Bryanston, Johannesburg	E-mail: jlues@iir.co.za Website: http://iir.co.za/juniorminingexploration /

HEALTH AWARENESS DAYS, WEEKS AND MONTHS

SEPTEMBER 2014

Childhood Cancer Awareness Month
National Heart Awareness Month
2-6 Back Awareness Week
23 Sep-20 Oct Eye Care Awareness Month

OCTOBER 2014

10 World Mental Health Day
16 World Spine Day

NOVEMBER 2014

14 World Diabetes Day
25 International Day for the Elimination of Violence against Women
25 Nov-10 Dec 16 Days of Activism for No Violence Against Women and Children

INTERNATIONAL MEETINGS

DATE	PLACE	MEETING	MORE INFORMATION
2-3 September 2014	Moscow, Russia	Central Asia Health and Safety Forum in Mining	E-mail: sonika.mendjoge@ flemminggulf.com Website: http://energy.flemminggulf.com/central-asia-health-safety-forum-mining
2-4 Sep 2014	Fukuoka, Japan	The 21st Asian Conference on Occupational Health	E-mail: acoh2014@mbox.med.uoeh-u.ac.jp Website: http://acoh2014.com/index.html
17-19 Sep 2014	Adelaide, Australia	Work Organization and Psychosocial Factors	E-mail: maureen.dollard@unisa.edu.au Website: http://unisa.edu.au/ICOHcongress
18-21 Sep 2014	Marrakech, Morocco	41st International MEDICHEM Congress	Website: www.medichem2014.com
24-26 Sep 2014	Porto, Portugal	International Congress on Environmental Health (ICEH2014)	E-mail: iceh2014porto@gmail.com Website: http://iceh2014.pt.to
29 Sep – 1 Oct 2014	Toronto, Canada	3rd International WDPI 2014 Conference on Work Disability Prevention	E-mail: sandra.knol@utoronto.ca Website: http://wdpi2014.iwh.on.ca/
21-23 Jan 2015	Dubai, UAE	4th ScienceOne International Conference on Environmental Sciences (ICES 2015)	Email: ices@thescienceone.com Website: http://thescienceone.com/ices

Health & Safety Forum gets local business "on spec" for new regulations

Construction is an industry fraught with danger, and there is new pressure for companies to protect workers and themselves by leading the way and confronting risks head-on. Positive, but major compulsory change lies ahead for many businesses due to the Government's amendment on 7 February 2014 of health and safety regulations regarding the construction industry. "Companies need to be aware that, in 2014, the new regulations will have a huge impact, not only on the construction industry; the main difference with the new law is that the regulations will also impact business and property owners," says OCSA's Occupational Medical Practitioner for the Mpumalanga region, Dr Hannes Raath.

NEW FORUM FORMED

OCSA, a leading business in workplace health and wellness, recently organised three industry experts to provide answers to the many questions that small and large companies have on the new 2014 legislation. "The clock has been ticking for the first phase of the roll-out to be implemented by 7 August 2014, and local businesses naturally have wanted this to be as smooth and simple as possible," says Dr Raath.

To fill the gap, OCSA intends to map out a clearer picture, together with industry players in all regions, nationally. In so doing, it will be able to provide collective support over the next 15 months until the deadline for implementation on 7 August 2015 is reached.

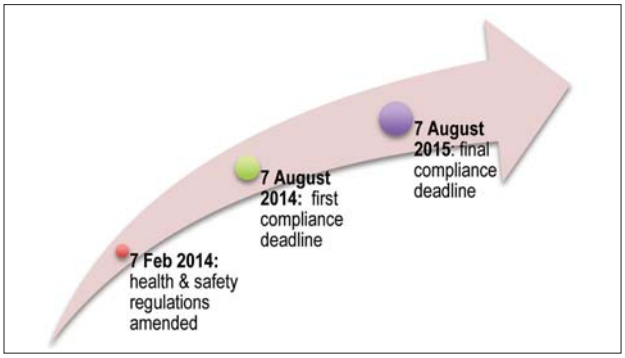
EXPERT OPINION

The value of OCSA's first event, held in Mpumalanga, was found in the team of opinion leaders and key speakers on the day. The Department of Labour's Inspection and Enforcement Services in Mpumalanga provided the detail about the latest regulations, while OCSA's Dr Raath focused on the shifts and changes of the regulations from a medical perspective. A safety expert talked about what employer's should include in their safety programmes, based on current regulations.

CLEAR UNDERSTANDING

The definition of "construction work" means that anyone involved in activity traditionally taken to be construction work will be subject to the new regulations. Any construction contract valued at R13 million or more requires a permit. Clients with such contracts, or any person for whom construction is being performed, are legally required to conduct a baseline risk assessment. This responsibility to ensure compliance with the regulations lies with all the parties, from the workers to the client, but particularly with the construction company.

- All employees on the construction site must now be in possession of a medical certificate of fitness.
- All examinations may be performed by an Occupational Medical Practitioner (OMP) or an Occupational Health Practitioner (OHP).
- Asbestos or lead regulations are an exception, where workers are required to be under the surveillance of an OMP. The Asbestos Regulation also provides for an OHP to perform pre-employment medicals.



Critical timelines for the implementation of the new health and safety regulations

TALKING REGULATIONS

At the launch of the amendment to the construction regulations in February 2014, the Minister of Labour, Mildred Oliphant, pointed out that the regulations provide a legislative platform for addressing health and safety in South Africa. The regulations will encourage competitive forces to work together for the good of the projects. The introduction of the construction works permit system requires that an application be lodged with the Department of Labour 30 days before construction commences.

Each application will be properly scrutinised to ensure that it meets the requirements for granting such a permit. For now, there will be no cost for this application, and a system has been put in place to ensure that there are no delays in the processing of the applications.

Another important aspect introduced in the regulations is the registration of construction professionals in accordance with Section 2 of the Project and Construction Management Act, Act No. 48 of 2000. The following categories of construction health and safety professionals have been identified:

1. Construction Health and Safety Agent (PrCHSA)
2. Construction Health and Safety Manager (CHSM)
3. Construction Health and Safety Officer (CHSO)

ACCIDENTS ARE PREVENTABLE

"Tragic incidents, such as the collapse of uThongathi Mall in KZN, which maimed and killed workers, tarnish the image of the construction industry, portraying it as an exploitative, cunning, and uncaring industry. In reality, the construction industry is the bedrock of our economy," said the Minister.

Construction work includes many hazardous tasks and conditions, such as work at height, excavations, exposure to noise and dust, use of power tools and equipment, working in confined spaces, and use of high voltage electricity. The new regulations are an important step for much needed collaboration on health and safety.

Report by Lisa Short on behalf of OCSA Communication
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1. Construction Regulations 2014 published in Government Notice R.84 of 7 February 2014 (Regulations 2003 repealed); available at: http://www.labour.gov.za/DOL/legislation/regulations/occupational-health-and-safety/construction-regulation-2014.
2. The Act can be found at: http://www.saflii.org/za/legis/num_act/pacmpa2000503.pdf.

Gloves In A Bottle lotion

The increase in global business and industrialisation has, unfortunately, many knock-on side effects. One is an increase in work-related dry skin conditions for employees.

Gloves In A Bottle (GIAB) is a shielding lotion that offers employees skin protection and care for dry skin, that really works. This statement is based on the following facts:

- GIAB is recommended and used internationally by more than 9 000 dermatologists and medical practitioners.
- Notable GIAB clients in the USA include BF Goodrich Tyre Co., United States Federal Reserve Bank, Ford Motor Company, Castrol Industrial, United States Dept. of Agriculture, Bank of America, Pacific Gas and Electric, and General Motors.
- More than 10 million bottles have been sold.
- GIAB is currently sold internationally in more than 20 000 chain store groups, pharmacies and hardware stores.

GIAB lotion is not a conventional moisturiser but is categorised as a SHIELDING lotion. A shielding lotion assists in locking out moisture-depleting irritants whilst simultaneously locking in the skin's natural moisture and oils. GIAB achieves this while still allowing the skin to breathe and perspire naturally. Excessive and consistent loss of natural oils and moisture from the skin inevitably results in dry skin conditions.

When applied, GIAB lotion adheres to the external layer of the skin, creating a similar effect to that of an invisible glove, assisting in shielding the skin from moisture-depleting irritants and locking in the natural moisture and oils that we require to maintain a healthy skin.

Employees who experience work- or otherwise-related dry, cracked, red, itchy or flaky skin, generally, as a first line of defence, purchase an over-the-counter conventional moisturiser which provides synthetic moisturisation. How often have you heard someone say that once they stop using their conventional moisturiser, their skin is worse than it was before using the moisturiser? The reason for this is that applying synthetic moisturisers to the skin sends off the "wrong" signal, duping the body into believing that it is producing sufficient natural moisture and oils for the skin. The moment that the synthetic moisturiser is no longer used, the skin has a reduced amount of natural moisture and oils available due to the "wrong" signal it received and, thus, the skin feels and looks worse than before. A never-ending circle, or a catch 22 situation, is created, i.e. one needs to continue applying the conventional moisturiser to achieve symptomatic relief whilst, sadly, the body continues to receive the wrong signal that it is producing sufficient natural moisture and oils.

The technology associated with GIAB is opposite to that of a conventional moisturiser. The skin is the largest organ of the human body and consists of seven layers. In order to achieve an effective moisturising result, it is important that moisturisation penetrates to, at least, the second layer of skin. GIAB achieves this as the natural moisture and oils of the body are assisted to optimally perform their function by being "locked in". Thus, the skin is successfully and naturally moisturised from the inside out without further promulgating a "wrong" signal to the body. In addition to this, the protective layer created when applying GIAB assists in locking out moisture-depleting irritants. Thus, a win-win situation is created when using GIAB. The results achieved are remarkable and are noticeable within just a few days of consistent use.

Unlike conventional moisturisers, an added advantage of using GIAB is that it does not wash off through the conventional washing of the skin but comes off through the natural exfoliation of the skin. A single application lasts 4 – 12 hours. Employees continue to achieve protection and dry skin care even after washing.

GIAB lotion is in no way a replacement for safety apparel and should be used in conjunction with recommended safety wear for those who experience work-related dry skin conditions. The product is suitable for use on hands, face and body.

If you have a workforce that experiences dry skin conditions for whatever reason, simply try GIAB lotion. See the amazing results and make an educated and cost-effective decision as far as dry skin care and skin protection for your employees are concerned. A healthy employee is a happy employee. Less "down time" = greater efficiency.

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Marikana autopsies highlight occupational diseases amongst platinum mine workers

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ABSTRACT

Background: **In August 2012, 34 platinum mine workers were shot and killed by police at Marikana. After forensic autopsies, the cardio-respiratory organs of the deceased men were sent to the National Institute for Occupational Health for examination for compensable disease in terms of the Occupational Diseases in Mines and Works Act (Act 78 of 1973).**

Methods: **A review of the autopsy records provides some insight into the health and social issues faced by mine workers employed on a South African platinum mine.**

Results: **Platinum mine workers experience high rates of silicosis and pulmonary tuberculosis, some of which can be attributed to cross recruitment, migrancy and the contract labour system. These problems are exacerbated by poor living conditions.**

Conclusion: **Many factors add to the burden of ill health of platinum and other mine workers. This small series of autopsies highlights some of the social and economic issues which persist, despite decades of research and resulting recommendations, primarily in gold mine workers.**

Keywords: **silicosis, tuberculosis, cross-recruitment, migrant workers, contract workers, compensation**

INTRODUCTION

Following failed wage negotiations and unrest in the area, approximately 3 000 striking platinum mine workers were gathered on a hill close to the town of Marikana, near Rustenburg, in the North West province of South Africa on 16 August 2012. The police dispersed the crowd on the hill and, in the course of this action, injured 78 mine workers and shot and killed 34 others. This incident and the events leading up to it are currently being investigated by a Commission of Inquiry chaired by Judge Ian Gordon Farlam.[1]

In terms of the provisions of the Occupational Diseases in Mines and Works Act of 1973,[2] the National Institute for Occupational Health (NIOH) examines the cardio-respiratory organs of deceased mine workers submitted to the Medical Bureau for Occupational Diseases (MBOD), for the presence of compensable disease. Data obtained from the examination of these organs are entered into a database known as PATHAUT. The database was established in 1975[3] and now contains demographic and pathological (macro- and microscopic) information on more than 100 000 deceased mine workers who worked in various South African mines and works. These data are in the public domain in the form of a series of annual reports[4] and have been used in the publication of more than 100 scientific papers and technical reports.

Following forensic autopsies, which are conducted on all individuals who die from unnatural (external) causes, the organs of the 34 deceased platinum mine workers were submitted for examination at the NIOH. Although these mine workers are not representative of all platinum mine workers in South Africa who die from external causes, they are a homogeneous group in that they were all working for the same mining company and they all died on the same day.

The purpose of this paper is to describe the respiratory autopsy findings in the mine workers who died at Marikana on 16 August 2012, in order to provide some insight into the health of mine workers currently employed on the South African platinum mines, some associated social issues, and the importance of the autopsy service offered in terms of the Occupational Diseases in Mines and Works Act.[2]

METHODS

Autopsies are conducted at the NIOH by skilled pathologists according to standardised methods. Silicosis in the lungs (pulmonary silicosis) is diagnosed when palpable nodules, evident on macroscopic examination of the lung parenchyma, are confirmed histologically, to display whorled concentric fibrosis. The severity of disease is determined by the number of silicotic nodules on macroscopic examination. If the

Table 1. Job descriptions of platinum mine workers by place of burial

Job description	Place of burial					All
	Eastern Cape	Gauteng	North West	Lesotho	Swaziland	
Rock drill operator	13	1		4		18
Winch driver	3					3
Stope worker	2					2
General miner	2					2
Equipper	1		1			2
Other†	2		1		1	4
Unknown‡	3					3
Total	26	1	2	4	1	34

† 1 team leader (Swaziland), 1 production and planning worker (Eastern Cape province), 1 pipes and tracks worker (Eastern Cape province), 1 engineer helper (North West province);
‡ 1 contract worker

nodules in the lungs measure more than 1 cm in diameter, progressive massive fibrosis (PMF) is diagnosed. Fibrotic nodules with the same histological characteristics as silicotic nodules in the lung parenchyma may also be evident in the lymph glands, and may be a sensitive indicator of the potential to develop silicosis.[5] Active pulmonary tuberculosis is diagnosed when epithelioid granulomas, associated with caseous necrosis, are present. Inactive tuberculosis is characterised by necrosis, surrounded by fibrous tissue; there are no granulomas.

If a currently or previously employed mine worker is diagnosed with a compensable disease in life, his employment history and medical records are reviewed by a panel of experts at the MBOD and a decision is reached with regard to his eligibility for compensation, based on a number of pre-determined criteria. The presence of disease, as well as the severity, is assessed. If the mine worker is certified as having a compensable disease, the necessary documents are sent to the Compensation Commissioner for Occupational Diseases where the employment record and other documents are checked and the beneficiaries are authenticated. The compensation amount is then calculated. Depending on the extent of the disease, the compensation is categorised as first or second degree.[6] The same procedure applies for disease diagnosed at autopsy.

The autopsy findings on the 34 mine workers recorded in the PATHAUT database were reviewed, together with records from the MBOD which were used to obtain employment histories and details with regard to certification of compensable disease.

The names, dates of birth and places of burial of the deceased were verified using information in Professor Peter Alexander and colleagues' book on the events that culminated in the shootings at Marikana in August 2012.[7]

Approval for the study was obtained from the University of the Witwatersrand Human Research Ethics Committee (clearance certificate no. M140275).

RESULTS

Demographic characteristics

All the deceased mine workers were black men and had a median age of 33 years (range 23 to 61 years). All worked for Lonmin Plc in Rustenburg: 19 at Karee Mine, 10 at Western Platinum Mine, and four at Eastern Platinum Mine (the name of the mine was unknown for one of the mine workers).

As shown in Table 1, the majority of the 34 mine workers were buried in the Eastern Cape province (n = 26; 76.5%).[7] We have assumed that they came to Marikana from that province to work on the mines. One (2.9%) was buried in Gauteng province, and only two (5.9%) were buried in the province in which the mines are located (North West province). Five of the mine workers (14.7%) came from neighbouring countries.

Most of the mine workers were rock drill operators (n = 18;

Table 2. Pathological findings of silicosis and/or PTB at autopsy by known employment history (n = 8)

Employment history	Silicosis in lungs & glands	Silicosis in glands only	Inactive PTB only	Inactive PTB + silicosis in lungs & glands
Platinum only	1†	1		
Platinum + gold	1	3	1	1

† Contract worker (diagnosed with pulmonary silicosis and PMF)

54.5%) of whom 13 (72.2%) came from the Eastern Cape (Table 1). Three of the remaining 13 mine workers from the Eastern Cape were winch drivers; two were stope workers; two were general miners; and one was an equipper. Four of the five mine workers who came from neighbouring countries, were rock drill operators. Only two miners (5.9%) were recruited locally from the North West province: one was an equipper and the other was an engineer helper.

The job descriptions of three of the mine workers were unknown; all were from the Eastern Cape. One of these mine workers was a contract worker. Although the precise nature of his work was unknown, it was noted he worked in a high dust environment, and had been employed at Western Platinum mine for 10 months. No other employment information was available.

Pathological findings at autopsy

Silicosis

At autopsy examination, three of the mine workers had silicosis, with nodules in both lungs and the peribronchial lymph glands (Table 2). Two of the three had mild silicosis and were previously employed in the gold mining sector. The third mine worker had silicosis with PMF. He was the contract worker for whom little employment information was available.

Many of the mine workers (n = 18; 52.9%) had previously been employed in the gold mining sector. Twelve of these men (66.7%) were rock drill operators, one of whom had also worked in a chrome mine for six years.

An additional four miners had silicotic nodules in the regional glands only; three had been previously employed in the gold mines. However, the fourth mine worker might have also been a former gold miner as there were gaps in his employment history: he died aged 34 years after working for less than nine years as a platinum mine worker.

The majority of mine workers with silicosis and or inactive PTB at autopsy had previously worked in the gold mining sector (Table 2).

Pulmonary tuberculosis

Inactive pulmonary tuberculosis (PTB) was noted in two of the mine workers at autopsy. One also had silicotic nodules in his lungs and both had worked in the gold mines before being employed on a platinum mine.

Other findings

Other findings at autopsy included mild emphysema (n = 2), fibrous pleural adhesions (n = 2), changes characteristic of smoking (n = 2), and bilharzia (Schistosoma) ova in the lung (n = 1).

Certification

The mine worker with inactive PTB and no silicosis at autopsy had previously been certified as having compensable PTB in life (case 8). Two other mine workers (both previous gold mine workers) were also certified as having compensable PTB in life but no PTB was diagnosed at autopsy (cases 4 and 9) (Table 3).

The contract worker (case 1) had extensive disease, warranting first degree certification (pulmonary silicosis and PMF). He was not diagnosed while alive. The other two mine workers in whom pulmonary silicosis was diagnosed at autopsy were also not diagnosed during life, but their silicosis was less severe and may therefore not have been evident on radiological examination.[8] One of the two also had foci of inactive PTB at autopsy.

In life, three mine workers had been sent for assessment to the MBOD: two with active PTB (cases 4 and 8) and one for a review of the radiological findings of fibrosis (case 9). The first had no PTB at autopsy, and the second had minute foci of inactive PTB. The third mine worker had no disease at autopsy, confirming the findings of the MBOD assessment panel after it had reviewed the radiological findings while the mine worker was alive.

Table 3. Diagnosis and certification of silicosis and/or PTB

Case	Disease(s) diagnosed at autopsy	Disease(s) diagnosed in life	Certification
1 †	Silicosis – lung & glands		After autopsy
2	Silicosis – lung & glands		
3	Silicosis – lung & glands Inactive PTB		
4	Silicosis – glands	PTB	In life
5	Silicosis – glands		
6	Silicosis – glands		
7	Silicosis – glands		
8	Inactive PTB	PTB	In life
9	Nil	Lung fibrosis	None

† A contract worker

DISCUSSION

Silica-related respiratory disease

Although a small group, these 34 mine workers provide some insight into the health of workers currently employed

on platinum mines in South Africa. The main finding from the examination of the respiratory organs at autopsy was silica-related pathology. This was severe enough to warrant certification for compensation in one mine worker. Seven of the 34 mine workers (20.6%) had concentric fibrosis in the lymph glands; three (8.8%) also had pulmonary silicosis. Silicotic nodules in the lymph glands are indicative of exposure to silica dust,[5] most probably during previous employment in the gold mines. Most of the men had records of having worked in the gold mining sector. Comprehensive employment histories were not available for two and they might have also previously been gold mine workers. Nelson and Murray (2013) found lower rates of silicosis and fibrosed lymph nodes at autopsy in a large group of platinum miners, viz. 12.7% and 2.2%,[9] most but not all of whom had been employed in the gold mines.

Cross-recruitment

The recruitment of silica-exposed workers into an industry in which silica dust exposure is not a major risk factor for disease has resulted in silica-related pathology in currently employed platinum mine workers, which has the potential to increase the prevalence of PTB.[10] Cross-recruitment within the mining industry is often from gold to platinum mines. Thus, workers exposed to silica dust, with disease or the potential to develop disease, may be employed in the platinum mining sector.

Contract workers

Workers with clinical or pre-clinical lung disease may also be recruited to work in the platinum mines through the contract labour system. Contract workers, many of whom are migrants, are especially vulnerable in terms of limited access to social, health and other services.[11] The most diseased mine worker was a migrant labourer from the Eastern Cape. The only employment history available was that he had worked on the platinum mine for 10 months prior to his death. However, he was 53 years old and it was very likely that he had been exposed to silica dust in the gold mines. Despite his extensive disease, there was no evidence that he had been diagnosed in life, and was thus not considered for certification with first degree compensable disease until an autopsy was performed.

Gaps in work histories

Available records could only provide information about the last 10 months of the contract worker's life, highlighting the problem of incomplete work histories recorded by many mining companies.[12] These 'gaps' in mine workers' employment records may compromise deceased mine workers' families in claiming financial compensation for occupational diseases contracted by the workers while employed on the mines because disease cannot be attributed to exposure. It may also limit research which attempts to establish associations between exposures to specific mineral dusts and the development of disease.

Pulmonary tuberculosis

HIV/AIDS and silica dust exposure are the two main drivers of the PTB epidemic in the mines.[13] An analysis of the prevalence of silicosis among deceased gold miners and ex-miners from 1975 to 2007 demonstrates a failure to control silica dust in the gold mines.[14] Silica dust in the South African gold mines has always been a health hazard. The Milner Commission (1902 – 1903) identified the importance of preventing the small particles of silica becoming airborne. Gorgas, reporting a decade later, said that laying the dust in the mines was the remedy for silicosis and later, the scientists working at the South African Institute for Medical Research (SAIMR) showed that miners and ex-miners died of PTB grafted onto "silicised" lungs.[15]

High rates of migrancy

Alexander et al. (2012)[7] state that most Lonmin mine workers were oscillating migrants, mainly from Pondoland in the Eastern Cape. Therefore, we have presumed that the province or neighbouring country where the burials took place was the place of origin of the mine worker. Only two of the 34 deceased mine workers were buried in the North West province. Five were buried outside South Africa

A platinum mine in the Rustenburg area *Photo courtesy of Gill Nelson*

and the majority (n = 26; 76.5%) were buried in the north eastern part of the Eastern Cape, a primary labour-sending area for the mining industry, approximately 1 000 km from Rustenburg. Thus, 31 of the 34 mine workers (91.2%) were migrants, indicating that the migrant labour system persists, together with the associated social, economic and health implications.[16]

Bilharzia

The mine workers at Marikana are at risk not only of contracting occupationally-related diseases. One of the 34 mine workers from the Eastern Cape had bilharzia (Schistosoma) ova in his lungs. He may have contracted this in the Eastern Cape. However, there is evidence for a risk of infection with bilharzia in Marikana, the presence of which is reported by the Bench Marks Foundation to be "a direct consequence of informal settlements, a major cause of which is the housing policies of mining companies, and failure to maintain and repair sewage and drainage systems by Local Government."[17] The Report states that the residential conditions under which Lonmin and other mine companies' workers live are "appalling", and cites a proliferation of shacks and informal settlements, the deterioration of infrastructure and broken drainage systems spilling directly into the river.

Benefit of the autopsy programme

The autopsy programme at the NIOH has been instrumental in enabling mine workers' families to receive financial compensation to cover loss of earnings from death due to compensable occupational respiratory disease. It is run by a team committed to assisting mine workers' families to claim compensation under the Occupational Diseases in Mines and Works Act.[2] In addition, the data clearly demonstrate the rising prevalence of silicosis and PTB in both the gold and platinum mines.[4] The data can be used to analyse occupational respiratory disease trends in all commodities. Disease surveillance, using the PATHAUT data, enables policy makers to monitor the impact of strategies implemented to improve the health of mine workers. However, ongoing maintenance of the PATHAUT database and the continued support of the autopsy system by stakeholders are essential in order to ensure maximum benefit for research, surveillance and administrative purposes.

Recommendations

There are lessons to be learned from this tragedy, not only with respect to industrial relations. The cross recruitment of silica-exposed workers into an industry in which silica dust exposure is not a recognised problem has resulted in the manifestation of silica-related pathology in platinum mine workers. Platinum mines need to introduce carefully designed screening and surveillance programmes for workers previously exposed to silica dust. The recruitment of former gold miners whose lungs may be assumed to have

been thoroughly "silicised" requires provision for careful entry examination and planned surveillance of a sub-group of the workforce at high risk of developing silicosis, PTB or both.

The majority of the platinum mine workers in this study were migrants. The migrant labour system compounds the health and economic burden of these workers.[16] The health and social needs, and access to health services, of migrant workers need be addressed to reduce the vulnerability of this large and important group of workers. Contract workers must receive the same medical benefits as permanent workers across the mining industry, including participation in medical screening and surveillance programmes.

The Department of Mineral Resources needs to introduce policies that will make the recording of comprehensive work histories, both within and outside the mining industry, by the mine medical services, mandatory.

It is the obligation of every mining company to inform its workers about the Occupational Diseases in Mines and Works Act,[2] to adhere to the requirements stated therein, and to assist mine workers' families with the procedures for submission of the cardio-respiratory organs for autopsy examination, which include providing complete employment records.

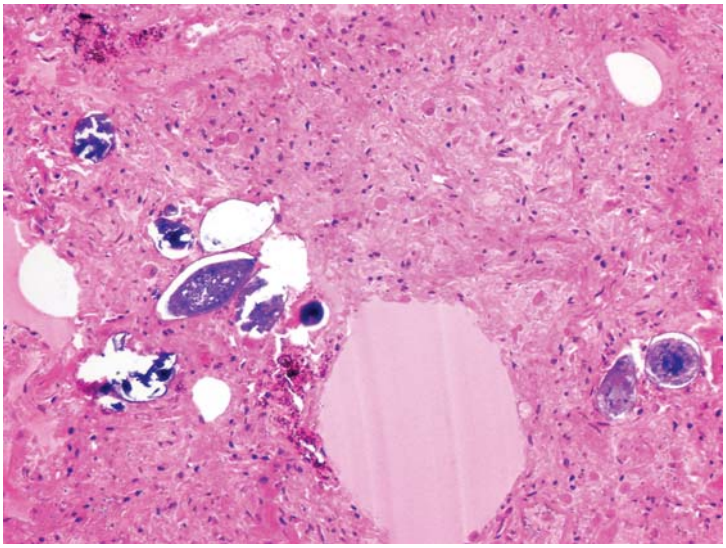
More research on occupational diseases is needed in the platinum mining industry, in line with that conducted in the gold mining industry, to aid efforts to improve the overall health of these mine workers.

Limitations

Autopsies were conducted on a small sample of platinum mine workers from a single company, but the reported findings nevertheless highlight issues that are currently experienced by all mine workers in South Africa. The rates of disease are not generalisable to all platinum mine workers but the purpose of this paper was not to estimate disease prevalences.

CONCLUSION

Many factors add to the burden of ill health of platinum mine workers. The Farlam Commission of Inquiry will examine the roles of Lonmin, the South African Police Services, Trades Unions, the Department of Mineral Resources, and individuals in the tragic events that occurred at Marikana on 16 August 2012. This paper provides evidence from the autopsy records of miners killed on that day for some additional underlying factors, namely, high rates of disease, cross recruitment between



A micrograph of a section of lung stained with haematoxylin and eosin, showing bilharzia ova

Photo courtesy of Dr Naseema Vorajee

mining sectors, the contract labour system, and migrancy, which may add to the health, social and economic problems of platinum mine workers. These issues persist, despite extensive research, primarily in gold mine workers, and subsequent recommendations and policies designed to alleviate the problems.

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CONFLICT OF INTERESTS

One of the authors (GN) is an editor of *Occupational Health Southern Africa*. However, this author played no role in the peer review process. There are no other conflicts of interest.

LESSONS LEARNED

1. Silicosis in platinum miners, much of which remains undiagnosed in life, is primarily due to exposure to silica dust in the gold mines.
2. Recruitment across mining sectors is common.
3. Employment records in the mining industry are often incomplete.
4. Migrants continue to work on the South African mines.
5. Contract labourers are a vulnerable group of workers.

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Occupational injuries in a large paper mill in South Africa

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ABSTRACT

Occupational injury data form part of the essential information needed for the overall accident prevention strategy for any workplace. The data are important in measuring safety performance, as well as identifying the most frequently occurring types of accidents within a workplace, with the aim of enhancing safety improvement strategies. This study investigated the types and causes of occupational injuries that occurred in a large paper mill in South Africa. A retrospective record review of all occupational injuries that occurred from 2000 to 2004 was carried out. The UK Health and Safety Executive's method of classifying occupational accidents was used. Three hundred and forty-one injuries were recorded in the mill's Safety Incident Register during that period. The highest proportion of injuries recorded was sustained by the mill's own employees (65.7%), with a five-year average injury incident rate (IIR) of 17.0 per 100 employees per year. The steady annual decline in the overall annual IIR (AIIR), from 17.3 per 100 employees in 2000 to 9.2 per 100 employees in 2004, was encouraging. Artisans, assistant workers, supervisors, and students employed for less than one year had the highest AIIRs, ranging from 38.8% to 17.8%. Wounds and eye injuries were the most frequently occurring injuries, at 41.6% and 26.7%, respectively, and were sustained primarily through slip related injuries (18.2%) and poor handling practices (13.8%).

Keywords: **pulp, occupational injury, injury incident records, record review**

INTRODUCTION

Paper is extensively used for packaging, communication and record-keeping purposes. Even though the world is moving towards a paperless environment, and South Africa has a highly developed electronic communication system, paper has remained an essential product, both locally and internationally. The demand for paper continues to increase worldwide, compelling paper manufacturing companies to continually increase their outputs.[1]

Available statistics on accident rates in this industry are limited. Compared to other manufacturing industries, the 1990 accident rate in the paper industry in Finland was below the national average; in Canada, the rates from 1990 to 1994 were similar to other industries; in the United States, the 1988 rate was slightly above average; in Sweden and Germany, the rates were 25% and 70% above the national average, respectively.[2]

The European Union (EU) has reported poor safety performance figures within the pulp and paper industry. In its 2002 Health and Safety Report, the EU revealed a fatality rate of 3.4 per 100 000 persons in employment and calculated that the average number of occupational injuries over the five years from 2000 to 2004 decreased by 3%.[3] Research in the United Kingdom (UK) revealed that the sector had an average accident rate of more than double that of manufacturing industries in the UK in general.[4] Poor safety performance trends were also reported by the UK Health and Safety Executive, through its Health and Safety Centre, which identified that, over a five-year period (1999 – 2003), the rate of serious injuries within the paper industry was approximately three times higher than that of other industries combined.[5] Probst and colleagues highlight the importance of ensuring safety behaviour among employees, arguing that complying with safety behaviours is related to longer term benefits.[6] They evaluated the Consideration of Future Safety Consequences (CFSC) scale among pulp and paper mill employees and they found that CFSC was an important predictor of safety. The CFSC scale measures safety attitudes, behaviours, and outcomes during working hours. In the United States, between 1994 and 2010, the number of workplace injuries in the paper and pulp industry declined at a faster rate than the national rate for all private industries (it declined from 8.8 in 1994 to 3.1 in 2010 per 100 workers per year in the paper and pulp industry compared to 8.4 in 1994 to 3.4 in 2010 per 100 workers per year in private industry).[7]

In South Africa, there is no published information on occupational injury statistics in the pulp and paper industry. The only available safety statistics are those published in the Compensation Commissioner's annual report, as required by the Compensation for Occupational

Photo courtesy of SAPPI

Injuries and Diseases Act (COIDA) of 1993.[8] These are occupational injuries reported to the Commissioner for the purpose of claiming financial compensation, following temporary total disablement (loss of days work or shift), permanent disablement (resulting in some permanent physical disability), or a fatality. According to the Commissioner's 2004 annual report, there were 217 680 occupational injuries reported for the year 2003/2004.[9] These figures show a decline of 1.4% (n = 3073) from the 1999/2000 reporting period. Of the injuries reported in 1999, 29% were from the manufacturing industry, into which the pulp and paper industry falls. According to the report, this was the second highest percentage in the country, following the transport industry.[9] The wood, paper and pulp sector includes both the formal and informal economies. This complicates analysis of the sector's employment and output. In 2005, the estimated number of employees in the sector was 735 000.[10]

The classification of injuries within workplaces varies according to national guidelines, usually in line with the country's Occupational Injury Compensation System. Internationally, classification is determined by the International Labour Organization (ILO) which has adopted a generic system of classifying occupational injuries according to the type of injury, the part of the body injured, and the size of the enterprise or establishment where the injury occurred.[11] In South Africa, there is no standard method of classifying occupational injuries, and each enterprise uses its own method of classification. However, there is a national trend to standardise the classification of injuries, as the different methods used generally adhere to the Compensation for Occupational Injuries and Diseases Act (COIDA)[8] and the Occupational Health and Safety Act.[12] The methods used, as specified by the two Acts, emphasise the severity of the injury, the part of the body injured and the cause of the injury. Importantly, when assessing whether an injury resulted in partial or permanent disability, it is often classified as a medical treated case (MTC), a lost time case (LTC), or a fatality. There is generally a lack of focus on less severe injuries such as first aid cases (FAC), creating a situation where there is variation regarding the recording, classification and monitoring of injuries within South African industries.

Study site

This study was carried out at one of the oldest and largest paper mills in South Africa, in Mpumalanga province. A company policy guides the general management of occupational injuries and incidents within its workplace, which encompasses the classification of injuries by the Risk Control Department – the same department

Table 1. Employee categories at the paper mill

Employee category	Description
Enterprise employee	a day or night shift employee of the enterprise (all departments)
Permanent contractor: engineering	a non-enterprise employee who resides on the mill premises and offers maintenance services
Permanent contractor: technical	a non-enterprise employees who resides on the mill premises and offers cleaning and other production support services
Permanent contractor: other	a non-enterprise employee who resides on the premises and offers security and catering services
Temporary contractor: engineering	a non-enterprise employee who does not reside on the company premises and offers maintenance services

that is responsible for maintaining the general safety system within the mill. The policy is compliant with the Occupational Health and Safety Act.[12] The procedure to be followed when an occupational injury occurs is specified in the policy. The injured person is immediately sent to the company medical clinic. After a physical examination, the attending health professional issues a medical report, specifying the extent of the injury. The injury is also classified and recorded in the Incident Safety Register by the Risk Control Assistant. The information captured in the medical reports includes a description of the injury, the time that it occurred, the part of the body injured, and the department and section in which the injured person worked. However, some minor injuries do not result in a visit to the medical clinic and are less likely to be reported and captured into the Incident Safety Register. As per the enterprise policy, each occupational injury is classified as a MTC, LTI, FAC or fatality.

The aim of this study was to investigate the types and causes of injuries that occurred in the paper mill during the five-year period, 2000 to 2004. The objectives were to describe the types, extents and severities of the occupational injuries that occurred, and to identify the most common types of injuries and in whom they occurred.

METHODS

The records of all the occupational injuries from 2000 to 2004, as recorded in the Incident Safety Register at the paper mill, were reviewed. Information collected included the part of the body injured, the type, nature and severity of the injury, the age and occupation of the injured person, and the shift in which he/she worked. The different employee types were categorised as described in Table 1.

The information from the Register was transcribed onto an occupational injury data capture sheet. All information was double-checked during its transcription to ensure accuracy. The injuries were classified according to the UK Health and Safety Executive's method of classifying occupational incidents, i.e. according to severity, type, and nature / cause of the injury, as well as the part of the body injured, occupation of the injured person, age category, shift category, and employee category. The data were entered into EpiInfo version 6, where they were analysed.

The five-year injury incident rate (IIR) was calculated as follows:

(No. injuries in worker category/(average annual number of workers in that category X 5)) X 100.

All information used in the study was kept confidential and anonymised using codes. The study was approved by the University of the Witwatersrand's Human Research Ethics Committee (clearance certificate no. M050931).

RESULTS

There were 341 injuries recorded during the study period. Table 2 summarises the severity of occupational injuries by employee category. The majority of the injuries (65.7%; n = 224) were sustained by enterprise employees. This group also had the highest proportion of injuries of all severities, i.e. 65.8% FACS, 63.0% MTCs and 70.0% LTCS. There were no fatalities in the study period.

Table 3 presents the distribution of occupational injuries according to their severity. Most were FACs (89.1%), with the highest proportions occurring in 2000 and 2002 (93% in both years). The proportion of MTCs was much higher in 2004 than the four years prior to this. There was an overall decline in the annual injury incident rate (AIIR) from 17.3 per 100 employees in 2000 to 9.2 in 2004, an overall reduction of 46.8%. The lowest AIIR was in 2003, at 6.8 per 100 employees.

Table 4 lists the types of occupational injuries by employee category. Wounds, eye injuries, sprains and burns were the most common types of injury, accounting for 93% of all injuries over the five-year period. More than 40% of the total injuries were wounds, such as cuts, lacerations, and bruises. Most of the injuries in enterprise employees and permanent contractors (engineering) were wounds (44.6% and 42.4%, respectively). Most of the other contractors injuries were

Table 2. Severity of injury by employee category, 2000 – 2004

Severity of injury	Employee category: Enterprise Employees		Permanent Contractor: Engineering		Permanent Contractor: Technical		Permanent Contractor: Other		Temporary Contractor: Engineering		All
	n	%	n	%	n	%	n	%	n	%	n
FAC	200	65.8	26	8.6	56	18.4	5	1.6	17	5.6	304
MTC	17	63.0	5	18.5	5	18.5	-	-	-	-	27
LTC	7	70.0	2	20.0	-	-	-	-	1	10.0	10
TOTAL	224	65.7	33	9.7	61	17.9	5	1.5	18	5.3	341
Average annual worker population	263		90		215		50		uk		618
IIR over five-year study period *		17.0		7.3		5.6		2.0		uk	

* describes how often an injury occurs per 100 employees [no. of injuries/(av. annual population X 5) X 100]

uk = unknown (for a category for which the size is unstable).

Table 3. Occupational injuries by severity, 2000 – 2004

Year	Average no. workers	FAC n	FAC %	MTC n	MTC %	LTC n	LTC %	Total n	AIIR*
2000	589	95	93.1	4	3.9	3	2.9	102	17.3
2001	637	72	91.1	5	6.3	2	2.5	79	12.4
2002	634	55	93.2	2	3.4	2	3.4	59	9.3
2003	662	39	86.7	4	8.9	2	4.4	45	6.8
2004	609	43	76.8	12	21.4	1	1.8	56	9.2
All	3090	304	89.1	27	7.9	10	2.9	341	10.9

*X^2 test for trend = 29.96 (p= 0.0000)

Table 4. Type of injury by employee category, 2000 – 2004

Type of injury	Employee category: Enterprise Employees		Permanent Contractor: Engineering		Permanent Contractor: Technical		Permanent Contractor: Other		Temporary Contractor: Engineering		All	
	n	%	n	%	n	%	n	%	n	%	n	%
Wound	100	44.6	14	42.4	21	34.4	1	20.0	6	33.3	142	41.6
Eye injury	43	19.2	12	36.4	24	39.3	3	60.0	9	50.0	91	26.7
Sprain	34	15.2	3	9.1	8	13.1	-	-	1	5.6	46	13.5
Burns	31	13.8	1	3.0	5	8.2	-	-	1	5.6	38	11.1
Fracture	3	1.3	-	-	-	-	-	-	1	5.6	4	1.2
Electrical shock	1	0.4	-	-	-	-	-	-	-	-	1	0.3
Other	12	5.4	3	9.1	3	4.9	1	20.0	-	-	19	5.6
Total	224		33		61		5		18		341	

Table 5. Causes of injuries by occupation, 2000-2004

Cause of injury	Occupation															
	Artisan		Ass. worker		General labourer		Operator		Other		Student <1 year		Supervisor		All	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Wind-related	15	16.1	9	36.0	30	45.5	10	18.9	4	57.1	4	12.1	10	15.6	82	24.0
Slip-related	23	24.7	-	-	6	9.1	7	-	1	14.3	4	12.1	21	32.8	62	18.2
Handling-related	14	15.1	6	24.0	9	13.6	8	-	-	-	5	15.2	5	7.8	47	13.8
Struck by	8	8.6	4	16.0	7	10.6	9	17.0	-	-	6	18.2	9	14.1	43	12.6
Burn	13	14.0	1	4.0	4	6.1	8	-	-	-	6	18.2	5	7.8	37	10.9
Struck against	8	8.6	1	4.0	1	1.5	6	11.3	-	-	-	-	3	4.7	19	5.6
Caught by	2	2.2	2	8.0	4	6.1	4	-	-	-	4	12.1	-	-	16	4.7
Arc welding	8	8.6	-	-	-	-	-	-	-	-	1	3.0	1	1.6	10	2.9
Other*	2	2.2	2	8.0	5	7.6	1	1.9	2	28.6	3	9.0	10	15.6	25	7.3
TOTAL	93		25		66		53		7		33		64		341	
Total ann. av. population	48		14		341		91		29		37		58		618	
Av. % of total population / year		7.8		2.3		55.2		14.7		4.0		6.0		9.4		
Five-year IIR		38.8		35.7		3.9		11.6		4.8		17.8		22.1		11.0

*includes bee stings, smoke inhalation

eye injuries. Eye injuries accounted for 26.7% of all injuries and resulted mainly from foreign bodies being blown into the worker's eye.

The causes of occupational injuries, arranged according to occupational category, are listed in Table 5. The majority of injuries were wind-related (24.0%) or as a result of slipping (18.2%), poor handling practices (13.8%), or being struck by something (12.6%). Burns, which accounted for 10.9% of all injuries, were due to caustic acid, steam, water, electricity, and contact with hot substances.

Assuming that each injury represented one employee, artisans were the most frequently injured group, with a five-year IIR rate of 38.8 per 100 employees. Assistant workers were the second most frequently injured group. However, this group comprised a small proportion (2.3%) of the workforce. Supervisors comprised 9.4% of the workforce: they were the third most frequently injured group with an incident rate of 22.1 per 100 employees.

DISCUSSION

The aim of this study was to investigate the types and causes of occupational injuries that occurred at a large paper mill during the five year period, 2000 to 2004. To the knowledge of the authors, injuries have not been investigated previously in the South African paper industry.

The study identified wounds, eye injuries, sprains and burns as the most frequently occurring types of injuries. Poor equipment and manual handling practices result in the worker being cut or caught by (or in/on) and struck by, an object causing wound injuries. Besides poor handling processes, slipping is another major contributor to injuries, where an employee can slip and fall or strike against a structure, or even become caught between structures. This has implications for the employer in terms of education and awareness training. Such training should ensure employees' appreciation of the dangers of poor handling of equipment and high risk areas for slipping.

The high prevalence of eye injuries during the study period demonstrates deficiencies in eye protection usage within the mill, especially with regard to employees working in the mill yard, chipper plant, power station and other outdoor areas. General workers, artisans and supervisors were the groups most seriously affected. More often, eye injuries are minor and classified as first aid cases. With respect to fatalities, the mill showed a relatively good performance, with no fatalities reported in the five year period.

In keeping with international research, poor performances were reported regarding injury rates. Specifically, the annual rate of 11 per 100 employees is higher than that of the wood

and paper industries in the UK for the period 1999 - 2003 as reported by a study by the Work Safe Health and Safety Centre in 2004[13] and much higher than that reported in the United States in a similar period.[7]

Major influences on the decline in total injuries over the study period were the reduction in the number of FACs (which constituted the bulk of total injuries) and total injuries within the enterprise and permanent and temporary engineering contractor employee categories. The decline in FACs was, however, counteracted by the increase in MTCs, especially in 2004.

"The wood, paper and pulp sector includes both the formal and informal economies . . . complicates analysis of the sector's employment and output."

Of particular concern is that, although the overall injury rate decreased over the study period, the mill's own employees was the group most affected. Encouragingly though, were the declines in the injury rates in 2003 and 2004 where, for every 100 employees, two and three employees sustained an injury, respectively. Further studies are recommended to explore reasons for the high prevalence of injuries within this group.

Despite the positive trends regarding the AIIR, occupational injuries, such as wounds, eye injuries, burns and sprains sustained through poor handling practices, poor personal protective equipment (PPE) usage (hand and eye protection), as well as slips and falls, remain major safety concerns within the workplace. Additionally, artisans and assistant workers are most affected by occupational injuries and general labourers are least affected. This may be indicative of a poor safety culture in the workplace.[9] The findings of the study highlight the need for renewed emphasis on injury prevention. The following recommendations will speed up the process of promoting an injury-free culture at the mill.

- Institute an integrated continuous safety awareness promotion programme, targeting all employees.
- Promote the appropriate use of eye and other protective equipment.
- Record all occupational injuries and incidents in the Safety Incident Register, regardless of whether or not the employee presents at the clinic.
- Collect more information to enable employers to better assess how to improve safety (through determining what factors are associated with occurrence of injuries).

The study was based solely on information derived from the Safety Incident Register. Further investigations are recommended to determine the contribution of weather conditions, behaviours (e.g. the use of PPE), attitudes (toward the use of PPE), and health and safety awareness, to the occurrence of injuries. This paper presents historical data. However, given the scant available literature on this topic in the South African paper industry, these results could serve as a baseline for monitoring the success of interventions or strategies to improve safety at the mill.

CONFLICT OF INTERESTS

One of the authors (AJS) is an editor of *Occupational Health Southern Africa.* However, this author played no role in the peer review process. There are no other conflicts of interest.

LESSONS LEARNED

1. There are few data on occupational injuries in the paper industry in South Africa.
2. Reporting using standardised nomenclature should be instituted in the industry, focussing on the most common causes of injuries.
3. First aid stations are important in the industry.
4. Trend analysis of injuries is important to measure the effects of safety controls.

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The Butterfly Tree
nurturing those in need

Malaria prevention

The Butterfly Tree has been given a licence to import two safe new products to use in the prevention of malaria and other vector-borne diseases.

Globally, malaria is the biggest killer of man: 75% of people who die from malaria are children under 5, mostly in sub-Saharan Africa.

The products could potentially save the lives of thousands of children and also help to prevent Onchocerciasis, commonly known as river blindness, caused by the black fly. In areas of the Northern and Western Provinces of Zambia, one in 10 people suffer from this condition and currently there are no preventive methods available in Zambia. The Ministry of Health and the Malaria Control Centre in Zambia have welcomed the products. They have been tested by the London School of Hygiene and Tropical Medicine in the UK and the active ingredients used have been approved by the World Health Organization.

The Butterfly Tree is to be given licences to import and distribute throughout Zambia. Besides using it for our humanitarian projects, we are contacting all corporates operating in the nation as this could be hugely beneficial to the mining, agriculture and tourist industries.

Many productive hours are lost as a result of malaria. By selling the products to corporate companies, we will be able to create sustainability for our water, health, education and community projects, in addition to extensively distributing the products to vulnerable communities.

The first product, MozziMort, is an insecticidal coating used on any hard surface, that lasts for two years and could replace the normal method of insecticide spraying which only lasts for six months. The second product, MozziMort Larvicide granules, prevents mosquito larvae reaching adult stage: http://biotechinternational.co.uk/.

The Butterfly Tree is a UK charity and NGO in Zambia, founded in 2006 by Jane Kaye-Bailey, to support rural communities decimated by the HIV pandemic in Zambia. The charity funds boreholes, health and education facilities, sustainable community projects and an orphan sponsorship programme. The charity's philosophy is to ensure that all donor funds go directly into the grass roots projects – no personal fees or administration costs are deducted. All members, both in the UK and Zambia, are volunteers.

For more information contact:
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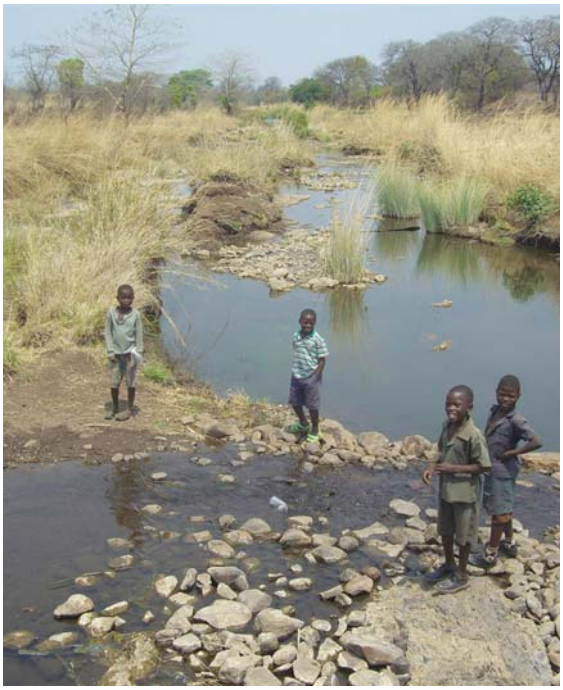
The Butterfly Tree: www.thebutterflytree.org.uk



Mosquitos breed in stagnant water – Siamasimbi Village

Young boy with malaria – Simango Rural Health Centre

Modelling the joint determinants of a positive malaria Rapid Diagnosis Test result, use of mosquito nets and indoor residual spraying with insecticide

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ABSTRACT

Background: **More than two thirds of the total population of Ethiopia is estimated to be at risk of malaria. Malaria is the leading public health problem in Ethiopia.**

Objective: **To investigate the determinants of a positive malaria Rapid Diagnosis Test (RDT) result, use of mosquito nets and use of indoor residual spray, as well as the associations between these and other factors.**

Methods: **Data obtained from a baseline household cluster malaria survey, conducted from December 2006 to January 2007, were analysed. In the survey, a total of 224 clusters, comprising around 25 households each, were selected from the Amhara, Oromiya and Southern Nation Nationalities and People (SNNP) regions of Ethiopia. A multivariate generalized mixed random effects approach was used to jointly analyse the data.**

Results: **The probability of a positive malaria RDT result decreased with use of mosquito nets and use of indoor residual spray. Overall, associations between a positive malaria RDT result and use of mosquito nets, and a positive malaria RDT result and use of indoor residual spray, were negative, i.e. households with more nets and those using indoor residual spray had fewer positive malaria RDT results. In addition, individuals in households with toilet facilities, clean drinking water and more living space had lower chances of testing positive for malaria.**

Conclusion: **Increasing the use of bed nets in Ethiopia and spraying indoor residual spray can reduce the risk of malaria, as can having toilet facilities, clean drinking water and more living space.**

Keywords: **Generalized Linear Mixed Model, Joint Model, Odds Ratio, Rapid Diagnosis Test**

INTRODUCTION

Malaria is a life-threatening disease, affecting the World's most under-developed countries. The disease is serious in regions lacking basic healthcare infrastructures.[1] In sub-Saharan African countries, malaria is a major cause of morbidity and mortality.[2] Moreover, it is a leading cause of death amongst children in many African countries.[3] In Ethiopia, malaria is also a major public health problem with 68% of the total population living in areas at risk of malaria[4,5]: 4-5 million people are affected by malaria annually.[6,7]

The highlands or highland fringe areas of Ethiopia, mainly areas at 1 000 - 2 000 metres above sea level,[8,9] are characterised by major malaria epidemics[7,10,11] This altitude covers 48% of the regions of Amhara, Oromiya and Southern Nations Nationalities and People (SNNP) regions of Ethiopia. The malaria epidemic has serious consequences for Ethiopia's subsistence economy as transmission peaks during the major harvesting seasons. Early diagnosis and prompt treatment is one of the key strategies for control.

The first priority in the acute stage of a malaria epidemic is the prompt and effective diagnosis and treatment of the disease. Having well-planned and timely vector control can significantly contribute to the reduction of the risk of infection which is caused by the Plasmodium parasite, and saving lives. To support the reduction of malaria distribution in Ethiopia, The Carter Center (TCC) for the Malaria programme in Ethiopia is working on two integrated disease control projects, viz. the Malaria and Onchocerciasis (MAONCHO) Programme; and the Malaria and Trachoma Programme. TCC has committed itself to provide sufficient long-lasting insecticidal nets to most parts of the country. In addition to the purchase and procurement of nets, TCC is also helping to distribute them within and outside its current areas of operation in the regions of Amhara, Oromiya and the SNNP region. In order for TCC to assist the Federal Ministry of Health of Ethiopia in the assessment and evaluation of its malaria control programmes, TCC needed to determine household net coverage and use, as well as malaria prevalence within these three regions. The activity of TCC helps the government of Ethiopia to develop strategies related to human resource development, and monitoring and evaluation, to control malaria and reduce the hardships it causes.

Based on this strategy, the main objective of the government is to make those areas with historically low malaria transmission malaria free, with a near zero malaria transmission in the remaining malarious areas of the country.[12] Malaria is regarded as a disease of the poor[13] and it is thus important to understand the relationship between malaria and poverty in order to develop coherent and effective policies and tools to address the problem.[14,15] As poverty is related to socio-economic factors, it is important to identify factors that are similarly related to the risk of malaria.

Malaria is commonly diagnosed clinically. The standard method of diagnosis is microscopy but laboratory facilities are not available in all areas of the country.[6,16] Recently introduced, the Rapid Diagnosis Test (RDT) for malaria offers the potential to extend accurate malaria diagnosis to areas where microscopy services are not available, such as remote locations, and after regular laboratory hours.[17] The tests use finger-stick blood, take only 10 to 15 minutes to complete, and do not require laboratory equipment. Non-clinical staff can easily learn to perform the tests and interpret the results.[18]

A study of the identification of the socio-economic, demographic and geographic risk factors is helpful to identify households that require intervention to reduce the risk of malaria. Studies conducted by Ayele et al. in 2012, 2013 and 2014 concluded that the malaria epidemic in Amahara, Oromiya and the SNNP regions of Ethiopia is associated with socio–economic, demographic and geographic factors. But, in some studies, the interest could be with multiple outcomes.[19-23]

The aim of this study was to investigate the joint effect of socio-economic, demographic and geographic variables on malaria RDT results, the use of mosquito nets, and the use of indoor residual spray in the last 12 months. The associations between malaria RDT result, use of mosquito nets and use of indoor residual spray in the last 12 months were also investigated.

METHODS AND MATERIALS

Study design

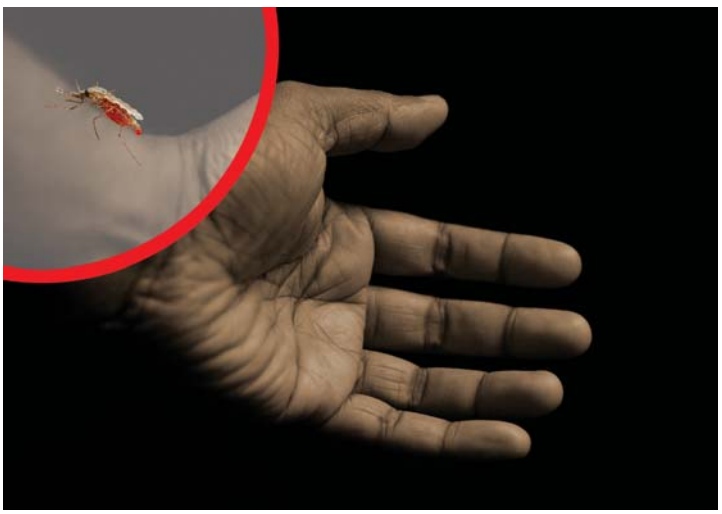
The baseline household cluster survey was conducted by TCC to assess the risk of malaria through the collection of household level baseline data for malaria risk indicators, including: housing construction, socio-economic status, availability of latrines and water, altitude, coverage of spraying, and use of nets. The survey was conducted from December 2006 to January 2007. A questionnaire was modified from the Malaria Indicator Survey (MIS) Household Questionnaire, and comprised a household interview and a malaria parasite form. The sampling frame was the rural populations (known as Kebeles – the smallest rural administrative units in Ethiopia) of Amhara, Oromiya and SNNP regions. For the baseline household cluster malaria survey, multi-stage cluster random sampling was used. By assuming the lowest measurement of prevalence malaria indicator, the sample size was estimated. Assuming prevalence of malaria to be the lowest indicator measured, the prevalence in the population was estimated to be 8%. In Amhara region, each zone was regarded as a separate domain; while in Oromiya and SNNPR, the community-directed treatment with ivermectin (CDTI) areas combined were taken as one domain. From the three regions, 5 708 households were included in the survey, covering 4 101 (71.85%), 809 (14.17%) and 798 (13.98%) households, respectively. Further studies on the sampling procedure for the survey were conducted by different researchers.[24-26] The sampling design was employed in order to select households within each first-stage cluster. From the 224 selected Kebeles, 25 households were chosen, from which 12 even-numbered households were selected for the malaria RDTs.

Sampling for mosquito testing

The rooms in each house were listed separately. For the survey, the number of sleeping rooms inside and outside the house was counted, as was the number of persons, to ascertain the occupation density per room. In addition, the number of persons sleeping under each net was recorded. The detailed sampling procedure is described elsewhere.[19,24,25] Informed consent was obtained from all participants and finger-prick blood samples were collected for malaria RDTs. The test used was ParaScreen which is capable of detecting Plasmodium falciparum and other Plasmodium species. Participants with positive RDTs were immediately offered treatment according to national guidelines.

Socio-economic, demographic and geographic variables

Identifying the socio-economic, demographic and geographic risk factors associated with positive RDTs is important. Therefore, the association between a primary outcome and another related outcome can disclose a great deal about the relationship between the response and socio-economic, demographic and geographic variables to reduce risk of malaria. For this study, related outcomes of the malaria RDT result were use of mosquito nets and use of indoor residual spray in the last 12 months.



Statistical methods

Joint modelling between binary outcomes was used. This has advantages over separate fitting of models: it better reduces type I error rates in multiple tests, improves efficiency in estimating parameters, and answers multivariate questions. In practice, there are difficulties in assessing the relationship between some covariates and all outcomes simultaneously. For multiple outcomes, two types of correlations must be taken into account, viz.1) the description of the dependency of each binary response on some covariates, and 2) the characterisation of the degree of association between pairs of responses and the dependency of this association on covariates.[23,27] Joint models are extensively used in many studies, and the literature on joint modelling is vast.[23,27-29] Methods focusing on models that jointly analyse discrete outcomes have also been explored.[30-33] The difficulties of joint modelling arise from the lack of multivariate distributions for combining both types of outcomes.

Because the specification of a joint distribution of the response is not straightforward, two approaches have been adapted. The first approach is based on a conditioning argument that allows joint distribution to be factored in a marginal component and a conditional component, i.e. avoiding direct specification of a joint distribution.[31,34,35] This method has a disadvantage in that it does not directly lead to marginal inference. Furthermore, the correlation between the two outcomes cannot be directly estimated.[23,27] Formulating a joint model for both outcomes, directly, is an alternative approach. In this study, a probit approach method was introduced by the first method. For the second

Table 1. Odds ratios for a joint model for malaria RDT result, use of mosquito nets and use of indoor residual spray for main effects

Parameter	Malaria RDT result				Use of mosquito nets				Use of indoor residual spray			
	OR	95% CI			OR	95% CI			OR	95% CI		
		Lower	Upper	P-value		Lower	Upper	P-value		Lower	Upper	P-value
Age	0.36	0.28	0.98	<0.0001	0.35	0.25	0.98	<0.0001	0.35	0.26	0.98	<0.0001
Gender (ref. Male)												
Female	19.89	19.91	21.68	0.5270	60.34	54.26	78.21	<0.0001	0.01	0.13	0.40	0.9910
Family size	1.07	1.03	1.14	0.0160	1.01	0.89	1.00	0.1390	1.04	0.97	1.10	0.0050
Region (ref. SNNP)												
Amhara	1.09	1.14	1.25	0.1021	0.94	0.99	1.06	0.9130	1.07	1.09	1.24	0.5820
Oromiya	1.09	0.19	0.96	0.9911	1.09	0.08	0.79	0.3020	1.17	0.14	1.14	0.2720
Altitude	1.00				0.99			0.0090	1.00			
Main source of drinking water (ref. protected water)												
Tap water	0.70	0.28	1.06	<0.0001	0.08	0.03	1.02	<0.0001	0.57	0.16	0.98	0.0001
Unprotected water	11.70	10.21	11.99	<0.0001	11.36	10.38	11.65	<0.0001	1.73	0.13	1.99	<0.0001
Time to collect water (ref. > 90 minutes)												
< 30 minutes	0.30	0.01	0.59	0.0001	0.29	0.08	1.36	0.0010	0.19	0.05	0.49	0.0001
30 - 40 minutes	1.57	0.28	1.48	0.1135	0.89	0.15	1.04	0.0250	0.09	0.02	0.50	<0.0001
40 - 90 minutes	0.89	0.09	0.97	<0.0001	1.60	1.86	2.98	0.1920	0.43	0.01	0.38	0.1460
Toilet facility (ref. no facility)												
Pit latrine	0.48	0.33	1.90	<0.0001	0.99	0.29	1.07	0.9650	0.09	1.21	0.18	0.0320
Toilet with flush	0.40	0.3	2.48	<0.0001	0.58	0.29	0.06	0.8570	0.15	0.01	0.77	0.0240
Availability of electricity (ref. no)												
Yes	7.94	6.48	8.33	<0.0001	9.97	5.34	10.3	<0.0001	7.69	3.69	8.12	<0.0001
Availability of television (ref. no)												
Yes	0.65	0.46	1.07	<0.0001	1.28	0.16	2.01	<0.0001	1.03	0.95	2.06	0.6400
Availability of radio (ref. no)												
Yes	0.53	0.68	2.47	0.7159	0.97	1.05	2.31	0.5390	0.55	0.16	0.85	0.0001
Total number of rooms	0.79	0.38	1.79	0.0041	0.61	0.14	1.09	0.0010	0.84	0.05	0.99	0.0001
Main material of room's wall (ref. cement blocks)												
Corrugated metal	0.59	0.11	0.69	<0.0001	0.04	0.01	0.34	<0.0001	0.47	0.13	0.68	<0.0001
Mud blocks	1.31	1.26	2.36	<0.0001	21.12	22.65	45.36	0.2500	0.08	0.05	0.58	<0.0001
Main material of room's roof (ref. corrugated metal)												
Thatch	1.54	0.52	2.36	<0.0001	1.67	0.07	1.97	<0.0001	1.17	0.97	2.05	<0.0001
Sticks and mud	3.35	2.12	5.36	<0.0001	1.84	0.18	1.99	0.0001	1.27	1.07	2.18	<0.0001
Main material of room's roof (ref. earth/local dung plaster)												
Cement	0.77	1.32	2.29	0.2470	0.02	0.01	1.87	<0.0001	0.002	0.02	0.41	0.2470
Wood	0.64	0.21	1.02	<0.0001	0.05	0.03	1.67	<0.0001	0.03	0.01	0.33	<0.0001

method, the Plackett-Dale approach was used. This second method assumed Plackett latent variable to model bivariate outcomes.

The main objective of joint modelling is to provide a framework within the interest of systematic relationships among the multiple outcomes, and between these and other factors. To obtain valid inferences, joint models must account for the correction among the outcomes and other effects of different factors.[36] The joint generalized linear mixed model (GLMM) assumes a GLMM for each outcome. The univariate models are combined through specification of a joint multivariate distribution for all random effects. Therefore, joint modelling can be considered as a new GLMM. Furthermore, the mixed model can be used by specification of the marginal distribution, conditional on correlated random effect. The GLMM forms a very general class of models for discrete responses in the exponential family.[37] The advantages of fitting a joint model over a separate model that contains use of mosquito nets and use of indoor residual spray in a linear predictor include possible gains in efficiency of the parameter estimates.[38] Each study participant's malaria RDT result (positive or negative) was modelled as a binary variable that follows a Bernoulli distribution.

To evaluate the association between malaria RDT result, use of mosquito nets and use of indoor residual spray in the last 12 months, the joint generalized linear mixed effects model was fitted. The three response variables could be taken to be independent at any point. In this joint model, the correlation between the three outcomes is specified through the random effects structure. This is done by assuming separate random intercepts for each outcome variable and then combining them by imposing a joint multivariate distribution on the random intercepts. The SAS procedure GLIMMIX (SAS 9.3) was used to fit the model. This procedure allows one to jointly model outcomes with different distributions and/or different link functions. The estimates from GLIMMIX were used as initial estimates for the NLIMIXED procedure. The conditional independence random effects model was fitted with SAS 9.3 PROC NLMIXED, using the general log-likelihood option. The NLMIXED procedure, using the general log-likelihood function, allows one to impose a joint multivariate distribution on the random effects from separate models. All statistical tests were conducted at a 5% level of significance.

The socio-economic, demographic and geographic linear predictors were: main source of drinking water; time to collect water; toilet facilities; availability of electricity, radio and television; total number of rooms; main material of the room's wall; and main material of the room's roof and floor. Geographic variables were region and altitude. Demographic variables were gender, age and family size. In addition to the main effects, some two-way and three-way interaction effects were included in the model. These interaction effects were: drinking water and roof material; time to collect water and floor material; time to collect water and main material of room's roof; age and gender; gender and main source of drinking water; gender and availability of electricity; gender and floor material; age, gender and main source of drinking water; age, gender and electricity; and age, gender and floor material. Malaria RDT result, use of mosquito nets and use of indoor residual spray in the last 12 months were binary outcome variables. These variables were jointly modelled using joint GLMM.

The study received approval from the Emory University Institutional Review Board (IRB 1816) and Amhara, Oromiya and SNNPR regional health bureaux.

"... the Rapid Diagnosis Test (RDT) ... offers the potential to extend accurate malaria diagnosis to areas where microscopy services are not available ... and after regular laboratory hours."

RESULTS

The result from joint models for malaria RDT result, use of mosquito nets and use of indoor residual spray in the last 12 months confirmed that malaria RDT result was influenced by socio-economic, demographic and geographic factors. The main factors that were found to be associated with RDT result were age, family size, altitude, main source of drinking water, time to collect water, toilet facility, availability of radio, television and radio, total number of rooms, main material of room's wall, main material of room's roof, and main material of room's floor (Table 1). The two-way significant interaction effects were drinking water and roof material, age and gender, gender and main source of drinking water, and gender and availability of electricity (Table 2). Age, gender and main source of drinking water, and age, gender and floor material, were found to be significant three-way interaction effects (Tables 1, 2 and 3).

The estimates of the significant effects are provided in Tables 1, 2 and 3. Based on the results, for each unit increase in family size, the odds of a positive RDT increased by 7.6% (OR = 1.076; 95% CI 1.033,1.143). The odds of a positive malaria RDT were lower for those individuals using a flushing toilet than for those with septic tanks (OR = 0.397; 95% CI 0.295, 2.477) or pit latrine slabs (OR = 0.477; 95% CI 0.327,1.895). For a unit increase in the number of total rooms, the odds of a positive RDT decreased by 20.1% (OR = 0.799; 95% CI 0.381, 1.786). The odds of a positive malaria RDT was lower for individuals with access to radio (OR = 0.535; 95% CI 0.475, 2.469), higher for households with electricity (OR=7.937; 95% CI 6.483, 8.329), and lower for households with access to television (OR = 0.651; 95% CI 0.461, 1.069).

There were significant two-way and three-way interaction effects (Table 2). One of the significant three-way interaction

Continued on page 25

Table 2. Odds for a joint model result for malaria RDT result and use of mosquito nets for interaction effects

Parameters	Malaria RDT result				Use of mosquito nets			
	OR	95% CI			OR	95% CI		
		Lower	Upper	P-value		Lower	Upper	P-value
Age and gender (ref. male)								
Female	4.16	1.22	5.21	<0.0001	2.69	1.01	3.21	<0.0001
Gender and main source of drinking water (ref. male and protected water)								
Female and tap water	0.12	0.08	1.21	<0.0001	0.09	0.04	0.25	<0.0001
Female and unprotected water	1.71	0.16	2.11	<0.0001	0.20	0.05	0.38	0.0010
Gender and availability of electricity (ref. male and yes)								
Female and no	0.12	0.09	1.10	<0.0001	0.04	0.01	0.59	<0.0001
Age, gender and main source of drinking water (ref. male and protected water)								
Female and tap water	0.72	0.16	0.99	0.0172	0.98	0.11	1.12	0.0001
Female and unprotected water	11.94	10.26	13.21	0.0144	0.99	0.08	0.97	0.2860
Age and gender and material of room's floor (ref. male and earth/local dung plaster)								
Female and Cement	0.63	0.23	1.03	<0.0001	2.93	0.23	3.08	<0.0001
Female and Wood	1.42	0.39	1.57	<0.0001	2.90	1.05	3.25	<0.0001

Table 3. Odds for a joint model result for use of indoor residual spray for interaction effects

Parameters	Use of indoor residual spray			
	OR	95% CI		
		Lower	Upper	P-value
Age and gender (ref. male)				
Female	2.69	1.01	3.68	<0.0001
Gender and main source of drinking water (ref. male and protected water)				
Female and tap water	0.09	0.05	1.69	<0.0001
Female and unprotected water	0.20	0.09	0.48	<0.0001
Gender and availability of electricity (ref. male and yes)				
Female and No	0.04	0.01	0.59	<0.0001
Age, gender and main source of drinking water (ref. male and protected water)				
Female and tap water	0.98	0.67	1.06	0.0001
Female and unprotected water	0.99	1.21	2.22	0.2860
Age, gender and material of room's floor (ref. male and earth/local dung plaster)				
Female and cement	2.93	1.22	3.02	<0.0001
Female and wood	2.90	1.09	3.11	<0.0001

Note: The unit of measurement for age is one year, family size is one person and total number of rooms is one room

Continued from page 23

effects was between age, gender and main source of drinking water (Figures 1 and 2). As age increased, a positive malaria RDT was less likely for males than for females who were drinking protected, unprotected or tap water. As age increased, malaria RDT was less likely to be positive for individuals who used tap water for drinking (males and females). More specifically, positive malaria RDTs increased with age for females but decreased for males. The figures further show that positive malaria RDT result between respondents using unprotected, protected and tap water for drinking widened with increasing age.

The second three-way significant interaction effect was between age, gender and material of room's floor (Table 2; Figures 3 and 4). As age increased, the odds of a positive malaria RDT also increased for males for all kinds of material used for roof construction. Individuals with cement floors had a lower risk of a positive malaria RDT result, followed by those with wood and earth floors. As age increased, the odds of a positive malaria RDT test for females also increased. Unlike for males, the risk of malaria for females was the same for all types of house construction.

Figure 5 presents the interaction effect between availability of electricity and gender for individuals. The prevalence of malaria was significantly higher for females than males who were living in a house with electricity. Similarly, females living in a house with no electricity had a significantly higher odds of a positive malaria RDT than males.

The random effects for malaria RDT result and use of mosquito nets were significantly negatively associated, i.e. -0.468 ($p < .0001$) (Table 4). This indicates a negative correlation between malaria RDT result and use of mosquito nets: increasing the use of mosquito nets decreased the chance of having a positive malaria RDT result. Similarly, the random effects from the joint model of malaria RDT result and use of indoor residual spray in the last 12 months were significant (-0.310, $p < .0001$), i.e. there was a negative correlation between a positive malaria RDT result and the use of indoor residual spray. Therefore, an increase in the use of indoor residual spray led to a decrease in the chance of having a positive malaria RDT result.

However, the conditional independence assumption might be too restrictive, and statistical tests to check the validity of the assumptions are not well-known in the literature. One way to solve conditional dependence is to fit the GLMM with malaria RDT as the response variable and include use of mosquito nets and use of indoor residual spray in the last 12 months in the linear predictor, an approach used by Gueorguieva.[38] The

Table 4. Variance components

Label	Est	SE	Pr > |t|
Var 1(RDT result)	0.632	0.042	<0.0001
Var 2 (use of mosquito net)	0.694	0.211	<0.0001
Var 3 (use of indoor residual spray)	0.828	0.101	<0.0001
Correlation between Var 1 & Var 2	-0.468	0.430	<0.0001
Correlation between Var 1 & Var 3	-0.310	0.212	<0.0001

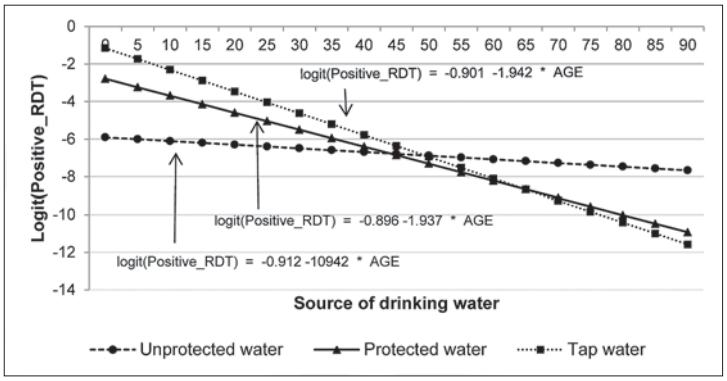


Figure 1. Log odds associated with rapid diagnosis test and age for male respondents with source of drinking water

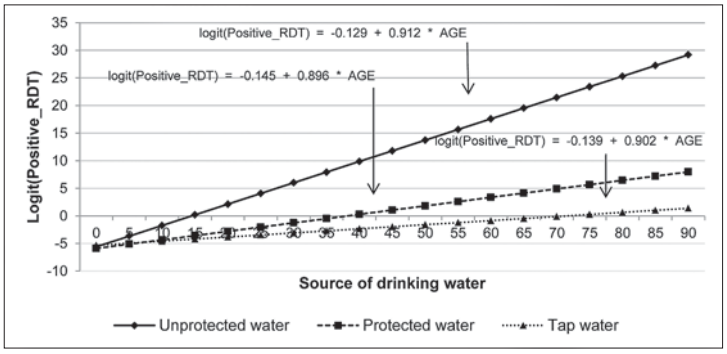


Figure 2. Log odds associated with rapid diagnosis test and age for female respondents with source of drinking water

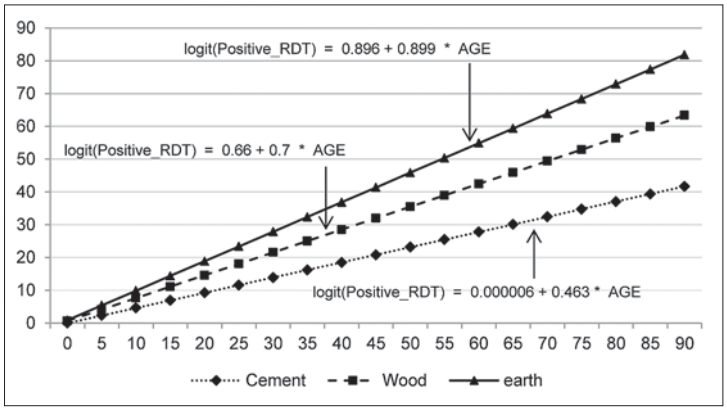


Figure 3. Log odds associated with rapid diagnosis test and age for male respondents with material for room's floor

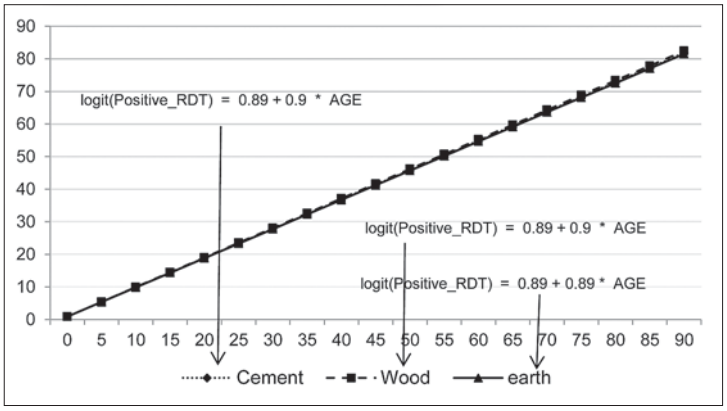


Figure 4. Log odds associated with rapid diagnosis test and age for female respondents with material for room's floor

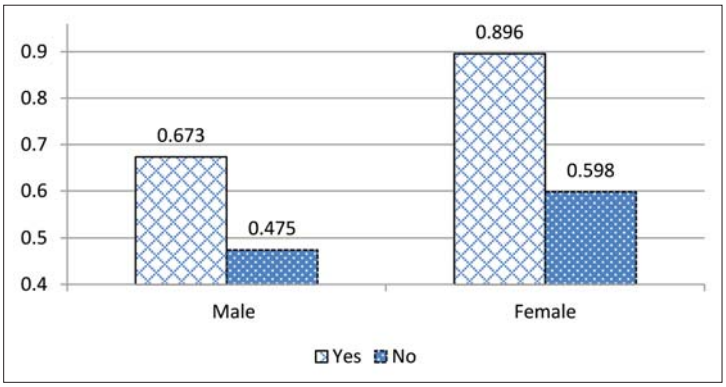


Figure 5. Log odds associated with rapid diagnosis test and availability of electricity with gender

results from all fitted models showed that a positive malaria RDT result was negatively associated with use of mosquito nets and use of indoor residual spray after controlling for socio-economic, demographic and geographic factors.[19] Furthermore, as the use of mosquito nets and use of indoor residual spray increased in the household, household members were less likely to have a positive malaria RDT result.

DISCUSSION AND CONCLUSION

The development of human resources, monitoring and evaluation to control malaria and reduce its risk are the main strategy of the government of Ethiopia. The objective is to reduce malaria transmission in those areas with historically high transmission, and to maintain the transmission-free status of the remaining areas of the country.[39] Based on studies conducted so far, malaria can be regarded as a disease of the poor or a disease of poverty.[13] The global distribution of malaria supports this argument because the concentration of the disease is in the poorest continents and countries. Better understanding of the relationships between malaria and poverty is important to design and implement policies and tools to tackle the problem. Since poverty is related to socio-economic factors, it is important to identify those factors that are also related to the risk of malaria.[14,15]

The present study was conducted based on a population-based household cluster survey. The findings showed that malaria RDT was negatively associated with use of mosquito nets. As the number of nets in a household increased, the number of individuals with positive malaria RDTs tended to decrease. Studies have been conducted in different parts of African and Asian countries[40-42] with the purpose of assessing the impact of the traditional use of bed nets on malaria morbidity. It was found that use of bed nets significantly reduced the rate of malaria morbidity. Similarly, malaria RDT and use of indoor residual spray were negatively associated. With an increase in the use of indoor residual spray, the number of individuals with positive malaria RDTs tended to be reduced. Different researchers have studied the effect of indoor residual spray in malaria risk,[10] examining the effect of malaria prevalence on the use of indoor residual spraying and the use of insecticide-treated bed nets in nine sub-Saharan countries. It was found that indoor residual spraying by itself was not a solution to reduce malaria risk, and that individuals who live in houses that were recently sprayed are more likely to use bed nets.[43-45]

This study presented here makes a methodological contribution to the literature of malaria and statistical models in the formulation and estimation of three discrete model systems by adopting a joint model methodology wherein flexible error dependency structures can be accommodated between discrete choice equations. To the knowledge of the authors, this is the first one in the malaria-related literature using the development and application of a joint model with an endogenous multinomial choice variable. Joint modelling provides efficient parameter estimates and the ability to answer multivariate research questions. The results from fitting a joint model of malaria RDT result, use of mosquito nets and use of indoor residual spray in the last 12 months indicate that a positive malaria RDT result is negatively associated with use of mosquito nets and use of indoor residual spray. In other words, in households that use fewer mosquito nets and less indoor residual spray, individuals have a greater risk of having a positive malaria RDT result. If households use more nets and indoor residual spray, the number of positive malaria RDT result might decrease. The findings of this study reaffirm the significant determinants of malaria RDT results reported by Ayele et al.[19-22] The results further confirm that socio-economic, demographic and geographic factors predict malaria RDT results through interactions among themselves or with other variables. For households with toilet facilities, clean drinking water and more living space, the chances of testing positive for malaria were lower than those without. The lack of indoor residual spray and lower household bed-net coverage allow for rapid spread of malaria. Moreover, using malaria nets and spraying the house walls were found to be effective control measures for malaria.

This study has some limitations. First, use of indoor residual spray was assessed by asking whether the house was sprayed with indoor residual spray or not. However, the transmission of malaria depends on the number of months for which the house was sprayed.[46] The number of months that the house was sprayed with insecticide in the last 12 months has also been shown to be associated with malaria RDT.[22] Second, interactions between variables were identified using the data and model fit techniques. The interactions were not pre-specified or expected during data collection. Detailed information on why these interactions influenced malaria RDT test was therefore not collected, and the reasons for some of these findings cannot be explained.

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CONFLICT OF INTEREST

The authors declare that they have no competing interests.

AUTHORS' CONTRIBUTIONS

DA acquired the data, performed the analysis and drafted the manuscript. TTZ and HGM designed the research. All authors contributed extensively to the work presented in this paper, discussed the results and implications, and commented on the manuscript at all stages.

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Arsenic – persistent hazard

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INTRODUCTION

Arsenic (As) and other heavy metals (mercury (Hg), lead (Pb), cadmium (Cd), antimony (Sb), chromium (Cr) and manganese (Mn)) are regarded as toxic to living organisms. Their tendency to accumulate, metabolize and target selective tissue is very often a result of their different oxidation states, such as As(V) or As(III). These highly toxic heavy metals have the potential to cross tissue membranes, which may lead to neuro-, nephro-, onco, terato- and immunological disorders.

The toxicity and mobility of arsenic in the environment is dependent on the chemical form in which it exists. Numerous arsenic species are present in the environment and biological systems. Like many other heavy metals, it exists in the environment in a number of oxidative states. It is only recently that scientists realized the impact that certain arsenic states have on the general health of workers. The Agency of Toxic Substances and Disease Registry and the United States Environmental Protection Agency have categorized arsenic as a human carcinogen.[1]

Occupational exposure to arsenic is a major concern for workers involved in the processing of copper, gold, lead, and antimony ores; producing and using arsenicals and arsenic-containing pesticides; burning of arsenic-containing coal in power plants; and treating wood with arsenic preservatives or working with such treated wood. Chronic low dose exposure to arsenic compounds is now officially a greater concern than acute exposure, mainly because of the carcinogenic effects of chronic exposure.

METABOLISM

About 70-90% of ingested inorganic arsenic is readily absorbed from the gastrointestinal tract and then distributed to different organs.[2] Organic arsenic, such as arsenobetaine (AsB), is absorbed completely. Soluble arsenic compounds, e.g. arsenic trioxide, is absorbed rapidly from the lungs, while lead arsenate and calcium arsenate dissolve slowly and are generally retained longer. Inorganic arsenic exposure times are the longest on the skin, and in the gastrointestinal tract, epididymis, thyroid, and skeleton, with the highest concentrations observed in the hair, nails, skin and lungs. Under ideal conditions, inorganic arsenic is methylated in the body, mainly in the liver, and excreted into the urine as free inorganic arsenic, viz. As(III) and As(V) at 10-20%, monomethylarsonic acid (MMA 10-15%), and dimethyl arsenic acid (DMA 60-80%).

Biomethylation of arsenic is the major metabolic pathway for the metabolism of inorganic arsenic in humans and other mammals. Figure 1 illustrates how (1) inorganic arsenate As(V) is reduced to arsenite As(III), (2) As(III) is oxidatively methylated to monomethylarsonic acid (MMAs(V)), (3) MMAs(V) is reduced to monomethylarsonous acid (MMAs(III)) and then further methylated to dimethylarsinic acid (DMAs(V)), and (4) further steps produce dimethylarsinous acid (DMAs(III)) and trimethylarsine oxide (TMAsO) which, in turn, can be reduced to trimethylarsine (TMAs(III)). The process of methylation is considered complete with the formation of DMAs (V) and probably di-methyl arsinous acid DMAs(III). Recent studies have identified the organic methylated trivalent species as being toxic – even more toxic than the inorganic arsenic species (As_2O_5 and As_2O_3).

There are confounders that affect the metabolism of arsenic. Medications, illicit drug use, herbal or traditional medicine, or a diet high in seafood may inhibit the effective metabolism of arsenic by the hepatic cytochrome P450 enzyme system. Confounders that inhibit the natural metabolic process or that deplete the active hepatic enzymes cofactor sites will also result in the accumulation of toxic substances which, in turn, lead to secondary health effects.

Very often, workers exposed to arsenic are subjected to other heavy metals such as Hg, Pb, tin (Sn) and thallium (Th) which compete for the same sites or follow the same detoxifying pathways. Such instances may result in the accumulation of metals. When arsenic exposure exceeds threshold levels or when confounders exceed the methylation capacity, excess arsenic can be retained for longer periods, resulting in the deposition of arsenic into target tissues with adverse health effects. It has been shown that cigarette smokers have significantly higher urinary total arsenic and MMA(V) levels, and lower secondary methylation index rates, than non-smokers.[3] It is possible that some chemicals in cigarettes compete for some of the enzymes or co-factors involved in the methylation processes, particularly those involved in the second methylation phase.

The capacity of exposed workers to metabolize and detoxify the adsorbed inorganic arsenic is believed to play an important role in disease development. This individual susceptibility may involve genetic and/or acquired factors. The proportional ratio of MMA/DMA or levels of urinary species can be used as indicators in the effective metabolism of inorganic arsenic. The concentration of inorganic arsenic in urine represents the unchanged proportion of the exposed dosage, while the MMA and DMA in urine represent the activity of the first and second metabolic phases, respectively.

HEALTH EFFECTS

Chronic exposure to high levels of arsenic has been correlated with cancers of the skin, bladder and lung, as well as hypertension

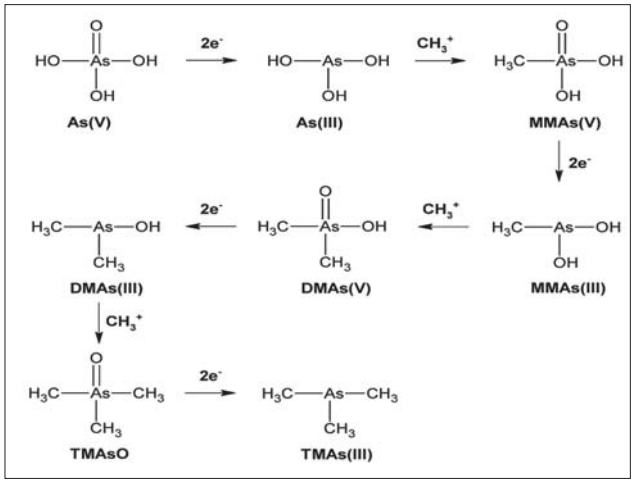

Figure 1. Biomethylation of arsenic

and cardiovascular effects.[4-6] Several studies on smelter workers suggest that chronic inhalation exposure to arsenic trioxide increases the risk of death from cardiovascular and cerebrovascular disease.[7-9] Acute intoxication from inorganic arsenic may cause irritation of the gastrointestinal tract and respiratory tract (rhinitis, pharyngitis, and bronchitis).[10] The skin is the critical organ affected, following long-term oral exposure. Skin and mucous membrane lesions include melanosis, hyperpigmentation, depigmentation, hyperkeratosis and skin cancer. Long-term exposure may also affect the peripheral nervous system and cardiovascular system, e.g. Blackfoot disease and Raynaud's syndrome,[11] as well as the haematopoietic system (anaemia and leukopenia).

THE CARCINOGENICITY OF ARSENIC

Significant evidence in the literature is available, suggesting arsenic's contribution to the incidence of human cancer. Epidemiological studies have demonstrated increased risks of lung cancer among workers exposed to arsenic.[10] Further evidence has demonstrated lung cancer in ore smelters and skin cancer in people exposed to arsenic-containing drinking water.[12] Although it has been more than 100 years since the carcinogenic properties of arsenic were suggested, it is still uncertain as to whether inorganic arsenic can cause other cancers apart from lung and skin. Stöhrer (1991)[13] concluded that: (1) more than 400 µg arsenic/day is required to cause arsenical disease; (2) skin cancer, internal cancer, and other non-cancerous effects of arsenic all have the same threshold dose and probably result from the same primary interaction; (3) hyperpigmentation can serve as a sensitive indicator of arsenic exposure and future cancer risk; (4) synergistic interaction changes the log-normal dose response slope but does not affect the intercept or threshold dose.

Possible mechanisms describing the carcinogenicity of arsenic are illustrated in Figure 2. Arsenite (the most likely active carcinogenic species) acts as a non-genotoxic indirect carcinogen, possibly via induction of oncogene expression and inhibition of DNA repair.

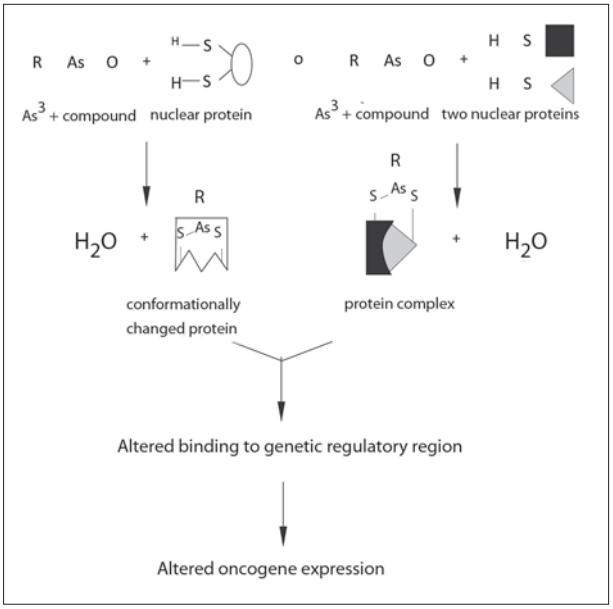

Figure 2. Proposed mechanism of arsenic carcinogenicity

BIOLOGICAL MONITORING

The true toxic status and bio-availability of arsenic compounds can only be determined if all known forms can be identified and quantified. The measurement of total arsenic in biological samples has, for many years, been the preferred method of identifying possible arsenic exposure. Recent studies have demonstrated the importance of arsenic specification in biological and environmental samples, as toxicity is generally dependent on their chemical structure and valency state.

The measurement of total arsenic concentration in urine represents the first step in identifying individuals exposed to arsenic compounds. Arsenic speciation, which includes the analysis of DMAs (V), MMAs (V) and the major inorganic arsenic species in urine, allows for a better understanding of the exposure, metabolic rate and species to which the individual has been exposed. Table 1 lists the different inorganic and organic arsenic species that have thus far been classified as possible carcinogens.

Table 1. List of arsenic species present in biological samples

Name	Abbreviation	Chemical formula
Arsenite, Arsenous acid	As(III)	$As(OH)_3$
Arsenate, Arsenic acid	As(V)	$AsO(OH)_3$
Monomethylarsonic acid	MMAs(V)	$CH_3AsO(OH)_2$
Monomethylarsonous acid	MMAs(III)	$CH_3As(OH)_2$
Dimethylarsinic acid	DMAs(V)	$(CH_3)_2AsO(OH)$
Dimethylarsinous acid	DMAs(III)	$(CH_3)_2AsOH$
Trimethylarsine oxide	TMAsO	$(CH_3)_3AsO$
Trimethylarsine	TMAs(III)	$(CH_3)_3As$
Arsenobetaine	AsB	$(CH_3)_3As^+CH_2COO^-$
Arsenochline	AsC	$(CH_3)_3As^+CH_2CH_2OH$
Tetramethylarsonium ion	Me_4As^+	$(CH_3)_4As^+$
Dimethylarsinoyl ethanol	DMAsE	$(CH_3)_2AsOCH_2CH_2OH$

Table 2. Biological monitoring of arsenic[15]

Measured by HPLC-ICP/MS *	Biological parameter measured	Biological matrix	Normal reference value	Maximum permissible concentration	Remarks
Arsenic	total arsenic	urine	<30µg/g cr.**	55 µg/g cr.	In the absence of seafood and arsenic-contaminated drinking water
		blood	< 10 µg/l		
		hair	< 1 µg/g		
	sum of As^{3+} & As^{5+} and MMA & DMA	urine	<10 µg/g cr.	55 µg/g cr. If TWA: 50 µg/m^3	
	inorganic arsenic As^{3+} & As^{5+}	urine	<1.5µg/g cr.	13 µg/g cr. If TWA: 50 µg/m^3	No interference from seafood

*HPLC-ICP/MS – High Performance Liquid Chromatography – Inductive Couple Plasma / Mass Spectroscopy

**cr = creatinine

Total arsenic in urine generally reflects inorganic arsenic if the intake of arsenobetaine in seafood is limited. Urinary concentrations of total arsenic in the range 50 to 100 µg/l may be due to seafood, dietary sources and supplements containing arsenic, or inhalation of air containing arsenic. In studies of smelter workers, a significant correlation was found between airborne time-weighted average (TWA) exposure to arsenic trioxide and the inorganic arsenic metabolites found in urine collected immediately after the shift, or just before the next shift.[14] Table 2 includes the proposed references for the biological monitoring of arsenic, with the different matrices that can be used for testing purposes.

As noted, workers exposed to arsenic are often subjected to other heavy metals, which can interfere with arsenic metabolism. It is therefore important to consider the analysis of these secondary heavy metals. The analytical toxicology data in Table 3 illustrate the importance of measuring the different arsenic species in workers who chronically exceed the urine arsenic biological exposure index (BEI) threshold. Urinary concentrations of arsenic are presented in µg/l and are expressed to creatinine as a ratio (µg/g). Table 3 highlights the importance of arsenic speciation versus the total arsenic concentration. The arsenobetaine concentration due to seafood intake should be noted in respect to the arsenic/creatinine ratio for samples 100/01 and 100/04.

Under ideal conditions, a ratio of 3:1 for DMA: MMA, is regarded as a good indicator of methylation efficiency.[16] However, this is not the case for workers chronically exposed to threshold levels of inorganic arsenic. The methylation efficiency ratio of DMA to MMA tends to be much closer to 3:2 in these individuals. More importantly are the high levels of inorganic As(III) and As(V) which exceed the recommended thresholds, indicating a fairly low rate of methylation and possibly resulting in the accumulation of arsenic compounds (body burden effect) over time.

CONCLUSION

The objective of occupational toxicology is to prevent injury to workers exposed to hazardous chemicals by determining whether certain set thresholds (BEI, BAT, OEL or TWA) have been exceeded. Technological advancements in the field of analytical toxicology has over time played an important role in the work of individuals chronically exposed to arsenic. Arsenic speciation and the analysis of other heavy metals provide valuable information to the practitioner, which may contribute to the overall effective management of individuals.

Table 3. Speciation data of urinary arsenic from workers exposed to high concentrations of heavy metals in dust particulate

Arsenic Speciation results (VM -ATLS results)											
	(µg/L) Total arsenic species (LC/ICP-MS)						Sum of As Species	Total ICP-MS		Creat	As/Creat
Sample	AsB	DMA	As(III)	MMA	As(V)		Tot As (µg/L)	Tot As (µg/L)	% Diff	g/l	µg/g
100/01	37.2	362.3	58.0	177.8	26.9		662.2	717.1	92.3	1.14	580.9
100/02		238.0	17.1	119.4	19.7		392.1	394.1	99.5	0.71	552.2
100/03		120.0	10.2	75.1	13.4		216.6	267.5	81.0	2.31	93.8
100/04	17.4	301.6	22.7	286.5	61.4		689.8	713.9	96.6	0.86	802.0

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Workmen's Compensation handing over 46 000 Iron & Steel Industry companies to Rand Mutual Assurance

The Department of Labour has gazetted its intentions to move the 1300 sub-class (Iron and Steel Industry) away from the Workmen's Compensation Fund and hand it over to Rand Mutual Assurance.

The intended handover is part of a turnaround strategy for the Compensation Commissioner to improve service delivery to companies. The Department believes this arrangement will facilitate the successful conclusion of the strategy but it has also assured that the Compensation Fund remains responsible for overseeing the compliance of the licensee with all the requirements of the COID Act.

The intended handover to Rand Mutual Assurance (RMA) does not come as a surprise as rumours have been going around for a while. The move will really serve the Iron and Steel Industry in many ways. This new initiative by the Compensation Commissioner, together with the new technology introduced over the past few years, will enable them to concentrate on other areas of service, for example, rebates, which have taken a back seat for a number of years. As the Iron and Steel Industry is the biggest sub-class in its portfolio, the handover is expected to alleviate the office of the Compensation Commissioner.

RMA has grown from strength to strength since its inception. It has a well-established track record in the management of claims for occupational injuries and diseases in the mining industry and has been administering claims since 1894. The ability by RMA to finalise claims for total temporary disablement and permanent disability within three to six weeks, depending on severity of the injury, is proof of a solid framework it has in place for handling claims.

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SAIOH MoU with the Department of Labour

The Department of Labour (DoL) and SAIOH have enjoyed a collaborative partnership for many years. SAIOH members serve on DoL technical committees (amongst others) and the DoL has representation at SAIOH's liaison forum. This partnership was recently formalised through the signing of a memorandum of understanding (MoU) between SAIOH and the DoL by the respective organisations' representatives – SAIOH President, PJ Jacobs, and the DoL Director General, Mr Samuel Morotoba.

The MoU officially recognises SAIOH as being responsible for "Professional Certification and Registration of Occupational Hygiene Practitioners in southern Africa". This is a milestone in SAIOH's illustrious history and something that we should use to continue motivating us on our path of continual improvement.

SANS 17020

A replacement of the ISO/IEC 17020:2012 application document for the accreditation of inspection bodies was recently published – ILAC P15: Application of ISO/IEC 17020:2012, and is available from the International Laboratory Accreditation Cooperation (ILAC) website: https://www.ilac.org/ilacp15062014.html. The SANAS Inspection Team will be reviewing all applicable documents, such as TR documents and checklists, to align these documents with ILAC P15:06/2014.

SAIOH President PJ Jacobs undersigning MoU while Bulelwa Huna from the DoL looks on

CPD RETURNS

I am pleased to announce that the electronic CPD return mechanism is now available on the SAIOH website. All CPD returns must be submitted electronically from 2015. In order to do so, all SAIOH members will be required to register on the SAIOH website. Please do this as soon as possible.

COMPENSATION/SALARY SURVEY 2014

This survey enjoyed very good participation, with more than 260 members responding to provide sufficient numbers within the various registration levels. Analysis of the responses is currently underway with the intent to have the report finalised and published before the SAIOH conference in October. I thank each of you who took the time to participate in the survey and I believe that the results will ultimately add value to our profession as a collective.

MENTAL HEALTH IN THE WORKPLACE

Mental health and the impact of stressful or high risk tasks on the human psyche have impacted on worker health worldwide, and will continue to do so. What are we, as occupational hygienists, doing to assist in managing these stressors in the workplace? The debates around shift work and the carcinogenicity thereof link to overall worker wellbeing and mental health. In my opinion, this is something that has never been properly addressed in workplaces around the world, but will become a topic of much discussion in the future.

SAIOH CONFERENCE

Please remember the SAIOH conference in Potchefstroom from 29 to 31 October. Check out the SAIOH website for further details.

COMMENTS AND VIEWS

Please remember to send us comments, views and any other information you may have about the profession, which you believe can add value. You can either e-mail me directly at saiohpresident@saioh.co.za or send an e-mail to admin@saioh.co.za.

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SASOHN news

SASOHN has a goal of promoting the professional role and status of its members through a number of objectives, of which continuing professional development is one. To this end, annual academic days are organised and held in two regions. This year, the days were held in Johannesburg (hosted by the Vaal Region) and Cape Town (hosted by the Western Cape Region) and had the theme "The wind in your sails – management for OHNPs." The presentations were clustered around management concerns that occupational health nurse practitioners (OHNPs) had identified in feedback from previous academic days. This year, a different approach was taken and speakers were invited from the regions in which the day was held, in contrast to previous years where the same speakers presented at both days.

The topics were largely the same and included:

- Work-life balance (Gauteng)
- Caring for the carer (Western Cape)
- OHNPs and their roles in ISO/OHSAS
- Retirement management
- Change management
- Financial management
- OH and EAP
- Sharing one electronic health record database (Gauteng)
- Time management (Western Cape)

The presentations were well received by delegates and generated much discussion.

Work-life balance, presented by Ms Angie Butkovic, was particularly relevant to OHNPs who tend to be working mothers. Many are furthering their studies and have community commitments in addition to their professional responsibilities. A number of ideas were provided to address work-life balance in members' own lives.

Professor Willie Pienaar spoke on 'Caring for the carer', using happiness to describe how OHNPs cope with the demands of their lives. Prof. Pienaar delved into the philosophy of happiness over the centuries and really inspired participants to continue to deliver exceptional occupational healthcare to those for whom they have responsibilities. He suggested that the OHNPs have managed to embrace the concept of happiness in their lives – people are happy in receiving but find true happiness in giving!

The presenters who spoke on retirement planning and financial management were most enlightening, and the number of delegates who said that they need to take these aspects of their lives seriously made the selection of topics worthwhile. The overriding issues in financial planning were budgeting and compound interest, while those in retirement planning were the importance of addressing the many facets of wellness in retirement – housing, hobbies/work or other interests, goals and objectives, amongst others. A holistic approach to retirement needs to be encouraged; too often we focus only on the financial aspects.

Anina Olivier (right), winner of the Ian Webster Silver Medal for the highest mark in a B Tech programme in South Africa being congratulated by Natalie Copeling, SASOHN PRO and Western Cape Committee Member

Mrs Wendy Da Cruz and Mrs Nell Browne, both experienced auditors, spoke on the role of OHNPs in management systems such as the International Standards Organisation (ISO) and the Occupational Health and Safety Assessment Series (OHSAS), and reinforced what many practitioners are doing. For those who are not involved in the management systems, the emphasis was on ensuring that occupational health becomes integrated into organisations' mainstream management systems. Nell Browne urged OHNPs to think of three things that they can do every day to improve quality occupational health and safety management in their departments.

Dr Jan Pienaar, from Anglo Thermal Coal, spoke about the electronic system of health records used by AngloAmerican, which generated much interest. This is an efficient, real-time system that facilitates a paperless environment.

Employee assistance (EA) programmes, an integral aspect of occupational health practice and often outsourced, were highlighted as a benefit to employees, and a means to improve productivity. In the current economic climate, many employees are battling psychosocial challenges and need assistance. EA practitioners urged OHNPs to utilise professional practitioners to address these issues.

Change management is a feature of all our lives but is not always readily embraced. Zodwa Mashishi and Dr Hilda Vember urged delegates to develop strategic plans – short, medium and long term – and to involve themselves in organisational change. They referred to a number of available resources to assist with this.

The overriding benefit of the academic day was that, as much as many of the topics were applicable to the OHNPs, there were many messages to take back to their practices to assist in the implementation of health-promoting activities in the workplace.

The academic day was also an opportunity for SASOHN to award academic excellence in the Society. SASOHN congratulates all the worthy recipients.

Janet Taylor Award for top marks for a Diploma in Occupational Health Nursing in South Africa:

- Aletta Palm (OCSA) – cum laude
- Chanel Lombaard (OCSA) – cum laude

Ian Webster Silver Medal for top marks for a B Tech Occupational Health Nursing in South Africa:

- Anina Olivier (CPUT) – cum laude

Ian Webster Gold Medal for completing a Masters Degree in Occupational Health

- Gail Irwin (UCT) – cum laude

Report by: Penny Orton, National Education Representative, SASOHN, e-mail: pennyo@dut.ac.za

Mine Medical Professionals' Association

17th Annual Congress

September 5 – 6, 2014

Kloofzicht Lodge, Muldersdrift, Gauteng

Register today!
CPD Accredited!

The Mine Medical Professionals' Association was established in 1921 to serve as the representative organisation of mine medical practitioners. Our mission today remains to raise the profile of mining medicine.

We invite you to become a member of the MMPA and enjoy the following benefits:

- Representation of the profession and other professional bodies
- A forum for the dissemination and publication of mining medical presentations and papers
- An opportunity for continuous professional development

The MMPA 17th Annual Congress will be held at the Kloofzicht Lodge in Muldersdrift, approximately 30 minutes' drive from Pretoria and Johannesburg. The venue is situated in a 500 ha conservation area bordering the Blaauwbank River. The main building overlooks 6 dams all with an abundance of trout, yellow fish and tilapia for the fly fishing enthusiast. The service and cuisine are of a superior standard and the Lodge with its retro African decor strives for a relaxed yet professional atmosphere.

Highlights of the Congress Programme

Official Welcome: Dr Vusumuzi Nhlapho, President

SEPTEMBER 5, 2014:

Dr Andre van Jaarsveld: An approach to Managing Fatigue in the Workplace.
Mr Kenneth Coster: Amendments to the Mine Health and Safety Act (MHSA): implications for managing health.
Professor Gill Nelson: Neuropathological effects of manganese exposure in miners.

GALA DINNER & KEYNOTE ADDRESS

SEPTEMBER 6, 2014:

Professor Lynne Webber: Managing the risk of travel in the mining industry: an update on key infectious diseases.
Dr Thuthula Balfour-Kaipa: The Mining Industry Health Milestones: history, progress and what next?
Dr Lindiwe Ndelu: Guidelines for comprehensive health management in the South African mining industry.




Sponsorship opportunities are available.
Exhibitors will be given exhibition space for both days and a speaking spot on the first day.

All enquiries can be directed to:
Ellen Garvie on 011 678 8307 or ellen@e-conference.co.za
Elaine Govender on 011 498 7759 or elaineg@mpas.org.za

www.mmpa.org.za

SASOM Scientific Guidelines

In days gone by, SASOM established some 20 Scientific Committees whose members had a specific interest in an aspect of occupational health and were prepared to share their expertise by writing guidelines to assist all occupational health practitioners. Pressure of work and very little time for formal discussion and the writing of guidelines have driven the Committees to near extinction.

The good news is that experts with different specialisations and interests have continued to write new – and update existing – SASOM Guidelines. From time to time, a group of experts still give up a whole day to discuss a new regulation or a contentious issue with the result that the latest information, in either a new or revised SASOM Guideline, becomes available to occupational health practitioners. Occupational health practitioners are welcome to inform the SASOM National Office of work situations or queries for which they need guidance. These messages will be relayed to experts on the subject for advice, and often find their way into an existing, or new, Guideline.

The SASOM Guidelines below are available on a CD from the SASOM National Office.

Please contact Jenny Acutt directly if you would like a copy of the CD.

A report on the African Regional Association of Occupational Health and the South African Society of Occupational Medicine Congress scheduled for 1 - 3 August 2014 will be published in the next issue of Occupational Health Southern Africa.

Report by Jenny Acutt, Project Coordinator, SASOM National Office, email: info@sasom.org

SASOM GUIDELINES 2014 – REVISED EDITION

NO.	TITLE
24	Accommodation of workers
9	Alcohol and drug abuse in the workplace
29	Audiometry in industry
14	Contact with blood and other body fluid
4	Design, equipment, staffing of OH centres and mobile units
12	Diabetes and employment
10	Epilepsy and employment
8	Food handling in industry
34	Health and safety training and health promotion
5	HIV / AIDS in the work place
25	Hypertension
22	Injuries on duty and occupational diseases
3	Management of absenteeism due to illness or injury
19	Management of medically incapacitated workers
2	Management of tuberculosis in industry
16	Medical records in industry
6	Medical requirements for fitness to drive
21	Medical surveillance, initial health evaluation, biological monitoring and exit health evaluation
27	Medicines in occupational health
7	Occupational health and safety policy
11	Occupational health audit
17	Occupational health ethics
28	Occupational health for health care workers
1	Occupational medicine practice
18	Occupational risk profiling
33	Personal protective equipment
23	Pregnant workers
20	Radiation: ionising and non-ionising (sun) and heat
13	Refrigerated cold environment work
31	Shift work
15	Spirometry in industry
30	The older worker in the work place
35	Transfer of an occupational health clinic
26	Vision in industry
32	Worker job specifications