

# OCCUPATIONAL HAZARDS, LIVING CONDITIONS, AND PHYSICAL ASSAULT OF SUGAR CANE WORKERS IN KWAZULU- NATAL, SOUTH AFRICA

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*Objectives.* To characterise the occupational hazards and living conditions of sugar cane workers in KwaZulu-Natal.

*Design.* Based on information provided by shop stewards, a survey instrument (questionnaire) was constructed for administration to union members.

*Setting.* Seven sugar cane farms and estates owned by one large corporation in late 1993.

*Subjects.* Members of the South African Farm and Allied Workers Union (SAFAWU).

*Results.* Of the 632 participants, 50% were permanent workers, 22.3% were seasonal workers and 27.7% were casual workers. Mean daily pay ranged from R5 to R35 per worker. The majority of participants reported substandard housing both during the growing season and during the off-season. Percentages reporting health problems in the last 12 months believed by the respondent to be caused or made worse by work included 79% with eye problems, 78% with upper respiratory problems, 88% with lower respiratory problems, 93% with musculoskeletal problems, and 81% with an acute traumatic injury. More than half the participants reported fainting, collapsing or illness from working on hot or sunny days. Fourteen per cent reported being struck with the fist or hand, or being pushed, shoved or kicked by a farm owner, member of the owner's family, manager or supervisor; 9% reported being struck with an object, whipped, or attacked or threatened with a knife or gun by one of these same individuals.

*Conclusions.* Sugar cane workers employed by a large corporation in KwaZulu-Natal appear to face severe threats to their physical and psychological well-being including: (i)



inadequate pay to meet basic living needs; (ii) substandard living conditions; (iii) significant occupational hazards resulting in high reported levels of occupational illness and injury; and (iv) physical and psychological abuse and intimidation by farm owners and their agents.

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## BACKGROUND

This study was conducted by the Industrial Health Unit (IHU) of the University of Natal in Durban at the behest of the South African Farm and Allied Workers Union (SAFAWU). At the time of the study, 1993 - 1994, SAFAWU was an independent agricultural union with approximately 7 000 members working on farms of various types in the KwaZulu-Natal region. The study was planned and co-ordinated with union leadership, the IHU, and an international consultant (TR).

This study represents the first systematic effort to characterise occupational health hazards among agricultural workers in KwaZulu-Natal, as well as the first study of such hazards among sugar cane workers in South Africa. It also represents an unusually comprehensive, broad-based examination of occupational hazards, living conditions and social circumstances among a particular group of agricultural workers. It is also one of very few studies of occupational health in South Africa to use a participatory approach, with substantial worker involvement in the study design and data collection.

## METHODS AND MATERIALS

During a 2-day meeting attended by staff and consultants for the IHU, 3 SAFAWU officials and 19 shop stewards working on 13 sugar cane farms were asked to systematically describe: (i) the process flow for growing and harvesting sugar cane; (ii) the specific work steps associated with each task listed in the process flow; (iii) the potential or actual hazards associated with each of these work steps; (iv) more general hazards not specific to any work step or task; (v) issues involving medical access and quality of medical care; (vi) prioritisation of the most important hazards; and (vii) recommendations for addressing these hazards. On the basis of these discussions, a survey instrument was drafted which addressed both occupational hazards of general concern and those specific to certain jobs, as well as more general issues to do with living conditions. This draft survey instrument was reviewed with union officials and with 14 of the 19 shop stewards who initially volunteered to administer surveys. It was then revised to include their suggestions. The draft survey instrument was also used as a training tool to demonstrate administration techniques to these 14 shop stewards, 11 of whom eventually

participated in data collection. Surveys were collected at the seven sites on which these 11 trained shop stewards worked, all of which were large-scale farms or estates owned by a single corporation. At these sites, surveys were administered by 47 SAFAWU members to a total of 632 union members over a 2-week period in December 1993, just before the close of the growing season. Only 11 of the 47 interviewers collected more than five surveys. These 11, all of whom had received training in interview technique, collected 370 or 87% of the 426 surveys on which the interviewer's name was listed.

Data were analysed in SAS. Firstly, descriptive measures including means and standard deviations were examined. Next, logistic regression models of all key occupational health outcomes were constructed. General health outcomes took the following form: 'In the past 12 months, have you had (specified health problem) caused or made worse by work?' Candidate variables for entry into these models included age, gender, years worked on current farm, years worked on sugar cane farms, type of labour (permanent, seasonal or casual), hours of overtime per day, highest monthly pay, and whether the individual had worked at one of the following jobs in the past 12 months: driving a tractor, handling aldicarb (a highly toxic carbamate with the brand name Temik), cutting seed cane, loading or unloading bags of fertiliser or chemicals, applying fertiliser to fields, mixing, preparing or applying herbicides, hoeing weeds, participating in a planned burning of a cane field, participating in controlling an accidental fire, reaping (cutting) sugar cane, baling sugar cane, using cables or chains to load or off-load bales, riding in a motorised vehicle or trailer to or from the cane fields, and handling chemicals where stored or loading chemicals onto trailers. Participants were also queried about job-specific health outcomes occurring over the past year. Candidate variables for entering logistic models for these job-specific health problems were reported working conditions specific to that particular job. Stepwise selection was used for determining variables in all final models. The *P*-value for retention in model was 0.05 for almost all models. However, for those models which did not initially converge, a *P*-value of 0.15 was used.

## RESULTS

The union provided information on the total number of members working at five of the seven farms on which questionnaires were administered. Four hundred and eighteen questionnaires were administered on these five farms, representing 41.7% of the reported union membership of 1 002 on these same farms. The percentage of reported union members who completed questionnaires ranged according to farm from 25% to 77.2%.

Demographic information stratified by job type concerning the 632 study participants is presented in Table I. Participants were overwhelmingly Zulu speakers, averaged 31 years of age,



Table I. Demographics by job type of KwaZulu-Natal sugar cane workers, 1993

	Permanent (N = 296)	Seasonal (N = 132)	Casual (N = 164)
Zulu speakers (%)	94.3	100	98.8
Mean age (years)	32.7 (12.2)*	29.7 (7.7)	28.0 (9.2)
Male (%)	67.5	92.3	43.2
Years worked on cane farms (% of permanent workers)			
≤ 2	17.4	6.4	23.6
> 2 - 6	28.3	28.8	35
> 6 - 10	18.8	27.2	22.3
> 10	35.5	37.6	19.1
Mean years worked on cane farms	10.5 (9.5)	9.8 (6.8)	6.7 (5.3)
Number hours worked/day (% of permanent workers)			
≤ 8	67.7	63.4	72.9
> 8 - 9	10.8	23.6	5.2
> 9 - 10	4.7	2.4	0.6
> 10 - 12	15.1	0.81	0.0
> 12	1.7	9.8	21.3
Mean number hours worked/day	8.8 (1.3)	8.9 (1.9)	8.8 (1.6)
Mean highest daily pay (rands)	14.22 (7.0)	15.96 (4.4)	11.61 (4.4)
Mean highest monthly pay	343.65 (197.9)	373.94 (109.7)	277.04 (98.7)
Mean lowest daily pay	11.58 (6.4)	12.29 (4.0)	8.13 (1.7)
Mean lowest monthly pay	322.87 (165.4)	304.46 (93.8)	200.24 (42.4)

\* Mean (standard deviation).

and approximately 66% were male. On average they had worked on sugar cane farms for 9.2 years, with approximately 33% working more than 8 hours per day, and 9% working more than 12 hours per day. Mean daily pay ranged from R5 to R35 per worker. Fifty per cent were permanent workers employed by the farm year-round, 22.3% were seasonal workers fully employed during the growing season, and 27.7% were casual workers hired on an as-needed basis during the growing season. When compared with casual workers, permanent workers were older, had worked more years on cane farms, and were less likely to work more than 12 hours per day. For each of these measures, seasonal workers fell between permanent and casual workers. Seasonal workers had the highest average pay, followed by permanent and then casual workers. The same pattern held for the percentage of males in each group. In comparing male with female workers (not shown), women were of similar age, had worked fewer years on cane farms (mean of 10.1 for males v. 7.7 for females), were less likely to work more than 12 hours per day (11.2% v. 5.7%) and received lower pay (mean highest daily pay R16.09 v. R9.75).

Table II presents reported living conditions of study participants. During the growing season, approximately 50% of the participants living on the farm owner's property reported living with their families, whereas only 9% of those living

elsewhere during the growing season reported doing so. Slightly over 66% of both groups reported living in crowded conditions. Most participants had electricity. However, only 31% of those living on and 17% of those living off the farm owner's property had indoor plumbing and only 33% of participants had mattresses and sheets to sleep on. Slightly over 33% of participants living on the farm owner's property had indoor cooking facilities compared with only 15% of those living elsewhere. About 90% of participants reported having toilet facilities during the growing season; however, less than 33% reported that these toilet facilities were well maintained. Among those who reported living off the farm owner's property in the off-season, over 80% reported living with their families and less than 40% reported living in crowded conditions. Also a higher percentage reported having mattresses and sheets to sleep on (63%), and approximately 66% reported having indoor cooking facilities. However, these participants were less likely to have indoor plumbing in the off-season (13%). Two-thirds had toilet facilities, and of this number slightly less than 50% reported the toilets to be in good working condition.

Three-quarters of participants reported living in a different place during the off-season than during the growing season. A clear majority reported migrating hundreds of kilometres or more.



Table II. Living conditions of KwaZulu-Natal sugar cane workers, 1993

	During growing season		During off season	
	Live on farm owner's property (N = 254)	Live off farm owner's property (N = 218)	Live on farm owner's property (N = 70)	Live off farm owner's property (N = 401)
% living same place as during growing season, or nearby	-	-	100.0	14.1
% living with own family	49.0	9.0	54.8	80.7
% living in crowded conditions	68.1	68.9	56.3	37.3
% having electricity	73.3	90.2	48.6	32.5
% having indoor plumbing	31.0	16.8	41.1	12.9
% having mattress and sheets	27.6	36.3	29.2	62.7
% having indoor cooking facilities	37.2	14.9	66.7	66.4
% having toilet facilities	88.6	93.8	76.7	66.6
If yes, % with toilet facilities in good condition	30.3	31.3	49.1	40.2

Table III presents the participants' reported health problems believed to have been caused or made worse by work over the last 12 months. The frequency with which specific health problems associated with work were reported ranged from 16% who were crushed, pinned or trapped by moving machinery to 86% who had lower back pain. Percentages reporting at least one problem to do with an organ system were uniformly high: 79% reported some type of eye problem, 78% some type of upper respiratory problem, 88% some type of lower respiratory problem, 93% some type of musculoskeletal problem and 81% an acute traumatic injury in the past 12 months. Other types of problems reported by more than half of the participants included large calluses or skin discolouration; fainting, collapsing or illness from working on hot or sunny days; and colds or flu from working on cold or rainy days. In addition, a substantial percentage of participants reported assaults. Fourteen per cent reported being struck with the fist or hand, or having been pushed, shoved or kicked by a farm owner, member of the owner's family, manager or supervisor (15% in males, 13% in females); 9% reported being struck with an object, whipped, or attacked or threatened with a knife or gun by one of these same individuals (9% in males, 11% in females); and 20% reported being attacked, robbed, molested, or threatened while walking through cane fields (20% in males, 19% in females). Only in relation to being crushed, pinned or trapped by machinery was there a statistically significant difference between genders (21% in males v. 7% in females).

Examples of specific work activities which were significantly

Table III. Percentages of KwaZulu-Natal sugar cane workers reporting health problems in the past 12 months caused or made worse by work, 1993 (N = 632)

	% reporting
Skin problems	
Skin burns or rashes	37.7
Large callus or skin discolouration	61.5
Eye problems	
Burning, stinging or tearing eyes	72.0
Medical care for dust or chemicals in eyes	57.4
Any eye problem (burning or required medical care)	78.5
Upper respiratory tract problems	
Sore throat or hoarseness	60.9
Stuffy nose, runny nose or nose bleeds	61.5
Any upper respiratory problem (nose or throat)	77.5
Lower respiratory tract problems	
Cough	80.8
Phlegm	65.2
Shortness of breath	61.8
Wheezing	61.1
Any lower respiratory problem (cough, phlegm, sob, wheezing)	87.5
Musculoskeletal problems	
Lower back pain	85.7
Shoulder or neck pain	76.0
Pain, numbness, tingling in arms, wrists, or hands	86.2
Any musculoskeletal problem (back, shoulders, neck, wrists or hands)	92.8
Acute traumatic injuries	
Serious cuts	66.0
Crushed, pinned or trapped by moving machinery	16.2
Slip or fall injury	48.7
Injured by falling object	25.5
Injured by animal	22.5
Any acute traumatic injury (cuts, crush, slip, falling objects or animals)	81.4
Causes of burns/respiratory problems	
Burned by a chemical	19.2
Burned by fire	32.8
Breathing or chest problems from inhaling smoke	68.5
Breathing or chest problems from inhaling chemicals	37.3
Exposure to the elements	
Fainting, collapsing, or illness on hot days	60.0
Colds or flu from working on cold or rainy days	84.3
Physical assaults and threats	
Struck with fist or hand, pushed, shoved or kicked by owner or agents	14.0
Struck with object, whipped, or attacked or threatened with a knife or gun by owner or agents	9.2
Attacked, robbed, molested, or threatened while in fields	19.8

positively associated with reported general health outcomes in logistic models (not shown) include the following: (i) controlling accidental fires associated with eye problems (OR 5.27 (1.36, 20.35), i.e. odds ratio of 5.27 with a 95% confidence interval of 1.36 - 20.35); (ii) cutting seed cane (OR 6.83 (2.26, 20.66)) and applying fertiliser (OR 12.75 (1.57, 103.58)) associated with upper respiratory problems; (iii) riding to work in a motorised vehicle or on a trailer associated with lower respiratory problems (OR 6.80 (1.89, 25.12)); (iv) cutting seed cane associated with musculoskeletal problems (OR 7.00 (1.26,



38.74)); (v) reaping sugar cane associated with acute traumatic injury (OR 7.08 (2.37, 21.15)); and (vi) cutting seed cane associated with fainting, collapsing or illness on hot or sunny days (OR 5.75 (1.92, 17.25)).

Table IV presents the prevalence of reported working conditions and health problems associated with specific jobs or tasks in the past 12 months. Specific jobs or tasks held by the majority of participants in the past year included having ridden in a motorised vehicle or trailer to and from the cane fields, cut seed cane lying in a furrow, hoed weeds, participated in a planned burning of the cane field, reaped

**Table IV. Prevalences of KwaZulu-Natal sugar cane workers reporting working conditions and health problems associated with specific job tasks in the past 12 months, 1993 (N = 632)**

	% reporting 'yes'
<b>Driving a tractor (N = 47, 7.4%)</b>	
Was it maintained in good condition?	69.0
Did it have roll bars?	63.9
Were you required to work alone?	61.5
Have you had a lost work day injury?	43.8
<b>Transported workers to or from fields (N = 131, 20.7%)</b>	
Did you receive special training?	29.3
<b>Handled aldicarb (N = 99, 15.7%)</b>	
Did employer provide rubber gloves?	18.5
Did employer provide gumboots?	20.0
Did employer provide overalls?	19.0
Did employer provide a rainsuit?	9.0
Did employer provide a mask or respirator?	16.3
Did you have a place to wash hands with soap and water?	20.0
<b>Who washes the clothes and gear?</b>	
Never washed	14.7
Myself	79.4
Someone else	5.9
<b>Did you become ill while doing this job or within a few hours?</b>	84.4
<b>Cut seed cane lying in a furrow (N = 489, 77.3%)</b>	
Have you had cuts serious enough to keep you off work for at least one full day?	70.0
Have you had backache or soreness?	92.9
Have you had to see a doctor or a nurse because of getting something in your eye?	64.6
Have you experienced breathing problems?	72.0
<b>Loaded or unloaded bags of fertiliser or chemicals (N = 327, 51.8%)</b>	
Have you had burning, stinging, or tearing eyes?	66.5
Have you had sore throat or nose problems?	70.5
Have you had breathing problems?	75.1
Have you had a lost work day injury?	70.3
<b>Applied fertiliser using a knapsack (N = 234, 37%)</b>	
Were you required to spray on windy days?	54.8
Have you had skin rashes or burns?	61.6
Have you had breathing problems?	75.7
Have you had back or shoulder pain?	92.5
Have you had numbness or tingling in your hands or arms?	86.9
<b>Stood in field to mark rows while chemicals were sprayed from an airplane (N = 52, 8.3%)</b>	
Have you had eye problems?	89.7
Have you had nose or throat problems?	92.1
Have you had chest or breathing problems?	95.1

**Table IV (continued)**

Have you become ill during this job or within a few hours?	87.8
<b>Prepared or applied herbicides (N = 145, 23.0%)</b>	
Were you required to spray on windy days?	96.5
Did employer provide rubber gloves?	25.5
Did employer provide gumboots?	48.1
Did employer provide overalls?	45.4
Did employer provide a rainsuit?	37.8
Did employer provide a mask or respirator?	15.5
Have you had skin burns?	68.6
Have you had eye problems?	73.7
Have you had nose or throat problems?	70.6
Have you had chest or breathing problems?	78.2
<b>Hoed weeds (N = 502, 79.5%)</b>	
Did you wear safety shoes?	27.8
Did you wear gloves?	4.4
Have you had backache?	89.5
<b>Participated in a planned burning of a cane field (N = 377, 59.6%)</b>	
Were fires ever set on windy days?	72.7
Did you receive fire safety training?	7.0
Did employer provide special clothing?	4.3
Did employer provide mask or respirator?	4.7
Have you had skin burns?	51.1
Have you had eye problems?	75.2
Have you had nose or throat problems?	73.4
Have you had chest or breathing problems?	75.5
<b>Participated in controlling an accidental fire (N = 175, 27.7%)</b>	
Did you receive any fire safety training?	15.7
Did you fire-fight at night before a work day?	87.4
If yes, were you required to work the next day?	100
Have you had skin burns?	46.5
Have you had eye problems?	80.3
Have you had nose or throat problems?	79.2
Have you had chest or breathing problems?	81.3
<b>Reaped sugar cane (N = 479, 75.8%)</b>	
Have you had skin irritation or rash?	49.3
Have you had a lost work day laceration?	73.1
Have you had medical care for something in the eye?	64.0
Have you had backache?	93.6
<b>Piled sugar cane bales (N = 385, 60.9%)</b>	
Have you had a lost work day injury?	60.8
Have you had shoulder or back pain?	93.0
<b>Used cables or chains to load or off-load bales (N = 154, 24.3%)</b>	
Were cables and chains inspected at regular intervals?	30.1
Were they replaced when they showed signs of wear?	23.2
Did cables or chains snap?	56.1
Have you had a lost work day injury?	52.2
<b>Rode in a motorised vehicle or trailer to or from cane fields (N = 571, 90.4%)</b>	
Was there an enclosed top?	13.4
Were there seats?	13.3
Was it overcrowded?	90.8
Were chemicals stored with passengers?	44.7
Did you jump onto moving vehicle if late?	69.8
Have you had a lost work day injury?	29.7
<b>Handled chemicals where stored or loaded chemicals onto trailers (N = 240, 38.0%)</b>	
Have you had skin burns?	63.4
Have you had eye problems?	83.1
Have you had nose or throat problems?	87.1
Have you had chest or breathing problems?	87.7



sugar cane, and piled sugar cane into bales. Many specific jobs or tasks were associated with a high risk of specific health problems in the past 12 months. For example, 84% of those handling aldicarb reported becoming ill while doing the job or within a few hours; 70% of those cutting seed cane lying in a furrow reported cuts serious enough to lead to a lost work day, and 72% experienced breathing problems. The majority of participants loading or unloading bags of fertiliser reported eye problems, upper respiratory problems, breathing problems and at least one lost work day as a result of injury. Among those applying fertiliser using a knapsack, the majority reported skin rashes or burns, breathing problems and back or shoulder pain. Of the 8.3% of participants who stood in the fields to mark rows while chemicals were sprayed from an airplane, more than 85% reported eye, upper respiratory and lower respiratory problems, and of those participating in planned burning of a cane field or in controlling an accidental fire, approximately 50% reported skin burns and approximately 75% reported eye problems, upper respiratory problems and lower respiratory problems. Almost 75% of those reaping sugar cane reported a lost work day as a result of laceration and 94% reported backache or soreness. Among those helping to pile sugar cane into bales, 61% reported a lost work day because of injury and 93% reported shoulder or back pain. Thirty per cent of participants reported having lost a work day due to injury associated simply with riding in a motorised vehicle to or from the cane fields.

For most of these specific jobs or tasks only a minority of participants reported using personal protective equipment or other hazard-prevention measures. For example, among those handling aldicarb, less than 20% were provided with rubber gloves, gumboots, overalls, rainsuits, masks or respirators, or had a place to wash their hands with soap and water. The majority of participants were obliged to perform tasks affected by the wind even on windy days which increased the risk of exposure and health problems. These jobs included applying fertiliser and herbicides, and planned burning of cane fields. Similarly, very few of those participating in the planned burning of cane fields had received any fire-safety training or been provided with special clothing, masks or respirators.

Table V presents the significant predictors of selected job-specific health problems in logistic regression models. Health problems associated with applying fertiliser using a knapsack were invariably positively associated with being required to apply the fertiliser on windy days. Health problems associated with application of herbicides were often negatively associated with the provision of personal protective equipment such as overalls, rainsuits, gumboots and rubber gloves. Health problems from participating in the planned burning of cane fields were uniformly positively associated with fires being set even on windy days and negatively associated with having received fire-safety training. Skin burns, eye problems, and upper respiratory problems were also positively associated

**Table V. Significant predictors of problems associated with selected specific jobs in logistic models among KwaZulu-Natal sugar cane workers, 1993**

	Odds ratio (95% confidence interval)
Applied fertiliser using a knapsack	
Skin rashes or burns	
Required to spray on windy days*	4.45 (2.34, 8.43)
Breathing problems	
Required to spray on windy days	4.08 (1.91, 8.71)
Back or shoulder pain	
Required to spray on windy days	7.23 (1.56, 33.64)
Numbness or tingling in hands or arms	
Required to spray on windy days	2.67 (1.11, 6.39)
Prepared or applied herbicide	
Skin burns	
Required to spray on windy days†	2.51 (0.76, 8.23)
Employer provided overalls‡	0.17 (0.07, 0.45)
Eye problems	
Employer provided overalls	0.26 (0.06, 1.09)
Employer provided rainsuit	0.27 (0.07, 1.04)
Nose or throat problems	
Employer provided gumboots	0.26 (0.07, 0.98)
Employer provided rainsuit	0.21 (0.06, 0.70)
Chest or breathing problems	
Employer provided rubber gloves	4.93 (1.17, 20.88)
Employer provided overalls	0.06 (0.01, 0.23)
Participated in planned burning of a cane field	
Skin burns	
Fire set on windy days	2.27 (1.32, 3.89)
Employer provided safety training	0.34 (0.11, 1.04)
Employer provided masks or respirators	6.96 (1.69, 28.60)
Eye problems	
Fire set on windy days	2.18 (1.24, 3.82)
Employer provided masks or respirators	5.70 (0.72, 45.11)
Nose or throat problems	
Fire set on windy days	2.53 (1.46, 4.39)
Received safety training	0.36 (0.13, 1.01)
Employer provided masks or respirators	3.92 (0.79, 19.44)
Chest or breathing problems	
Fire set on windy days	3.32 (1.88, 5.89)
Received safety training	0.38 (0.11, 1.28)
Employer provided special clothing	32.48 (1.97, 534.56)
Employer provided masks or respirators	0.11 (0.02, 0.54)
Used cables to load or off-load bales: lost work day injury	
Cable snapped	5.92 (2.61, 13.44)
Rode in motorised vehicle to or from cane fields: lost work day injury	
Vehicle overcrowded	2.61 (1.02, 6.69)
Chemicals stored with passengers	4.30 (2.72, 6.81)
If late, must jump onto moving vehicle	4.14 (2.14, 8.03)

\* Candidate variables for entry into (retention in) each logistic model were the working conditions listed under each specific job task in Table IV.

† There is a single logistic model for each health outcome, e.g. these two variables were retained in a single model predicting skin burns associated with preparing or applying herbicides.

with the provision of masks or respirators, whereas lower respiratory problems were negatively associated with this, but very strongly positively associated with the provision of special clothing. Injuries resulting in lost work days while riding in a motorised vehicle or trailer to or from the cane field were positively associated with overcrowding, chemicals being



stored with passengers and those who were late being required to jump onto a moving vehicle.

Frequencies for the various health outcomes and work conditions were also examined, stratified according to farm (data not shown). In general, there was substantial variation in the frequency for many of the variables depending on the farm on which the participants worked. In many instances different reported frequencies of health problems appeared to be associated with differences in reported frequencies of relevant working conditions. For example, none of the participants handling aldicarb on one farm reported becoming ill while performing this job or shortly afterwards. One hundred per cent of these participants reported that their employer provided boots, overalls, masks or respirators for performing this job, whereas the frequency of provision for these items was less than 50% at the other six sites.

## DISCUSSION

In formulating any conclusions from the findings, it must be borne in mind that this study represents a snapshot of reported conditions in 1993. There may have been substantial improvements in these conditions over the last 4 years under the new national and provincial governments, as well as with the introduction of more protective occupational health and injury legislation. We have no specific information regarding this. The rest of this section will proceed on the untested assumption that the majority of working conditions and associated health problems reported in 1993 still exist. It should also be borne in mind that these findings represent conditions on the sugar cane farms and estates of one large corporate employer. This corporation employs several thousand of an estimated total of 80 000 sugar cane workers in KwaZulu-Natal (Sipho Kumalo, Southern Natal regional secretary for the South Africa Agricultural, Plantation and Allied Workers Union — personal communication, 1997). The extent to which these conditions would be representative of other corporate employers or of smaller, family-owned farms in KwaZulu-Natal is uncertain. Evidence from prior studies suggests that physical violence is more likely to occur on smaller farms.<sup>1,3</sup>

The survey findings, in combination with anecdotal information provided by the shop stewards and union officials interviewed, suggest that sugar cane workers employed by a large corporation in KwaZulu-Natal face severe threats to their physical and psychological well-being. These threats appear to include: (i) inadequate pay to meet basic living necessities and associated substandard living conditions in housing both on and off of sugar cane owners' property; (ii) the presence of significant hazards associated with specific jobs and tasks resulting in high reported levels of occupational illness and injury; (iii) lack of access to adequate and impartial medical care; and (iv) physical and psychological abuse and intimidation by farm owners and their agents, as well as lack of

personal safety when working in the cane fields. Each of these is addressed in more detail below.

**Low pay.** Minimal reported daily earnings, in the range of R5 - R7.64, are also the modes for this population, i.e. the most frequently reported pay. This level of pay, although an improvement on reported pay scales among non-unionised farm workers in the recent past,<sup>1,2</sup> still appears grossly inadequate to support a single individual, much less a family, even in the event that food and rent during the growing season are covered by the employer.

**Living conditions.** As summarised in Table II, participants are faced with substandard living conditions both during the growing season on or off the farm owner's property and during the off-season. Substandard conditions when living off the farm owner's property probably reflect a combination of rural underdevelopment and lack of adequate pay. Substandard living conditions on the farm owner's property are, of course, the direct responsibility of the owner and cannot reasonably be 'excused' on the basis of off-farm living conditions. It may be expected that these physical and psychological deprivations will interact with any direct occupational hazard to increase the probability and severity of illness or injury.

**Hazards of work-related acute trauma.** Two-thirds of participants reported serious work-related cuts in the past year and nearly 50% reported a slip or fall injury, with a total of 81% reporting some type of acute traumatic injury. As is true for the other reported rates of illness or injury, there was no population completing a similar survey instrument available for comparison. However, these rates appear inordinately high when compared with rates based on self-report or injury and illness records in developed countries.<sup>4,5</sup> An examination of which variables predict an increased risk for such injury outcomes sheds additional light on the situation. The risk of serious cuts in the past year was associated with riding in a motorised vehicle or trailer to or from the cane fields, where crowded conditions, workers carrying bush knives and overtime fatigue were most likely contributing to the risk of injury. The risk of slip and fall injury was associated with participation in controlling accidental fires which often occur at night, involve smoke obscuring vision and chaotic activity. The risk of any acute traumatic injury was associated with reaping sugar cane, as this requires forceful cutting with a bush knife below knee-level, and is often associated with reported severe lacerations of the lower legs.

**Chronic or sub-acute musculoskeletal problems.** As shown in Table III, participants reported very high rates of musculoskeletal problems involving the back, neck and shoulders and upper extremities. As shown in Tables IV and V, cutting seed cane lying in a furrow (which requires forceful exertion in hyperflexed position of the back), applying fertiliser with the use of a knapsack typically weighing more than 40 kg when full, reaping sugar cane, and piling sugar cane into bales



were each associated with a greater than 90% risk of back or shoulder pain. Applying fertiliser in which the weight of the knapsack was largely supported by shoulder straps passing under the arms was associated with numbness or tingling in the hands or arms in 87% of participants. These data suggest that sugar cane workers face severe ergonomic hazards in several job/task categories.

**Chemical hazards.** Sugar cane farming involves the intensive application of fertilisers, pesticides and herbicides. The greatest concerns with regard to these are: (i) the use of aldicarb (Temik), a highly toxic carbamate (rat oral LD<sub>50</sub> is 1 mg/kg) which is used as a nematocide — carbamates are a class of anticholinesterases which may be associated with severe acute toxicity; (ii) paraquat-containing herbicide mixtures mixed in the field and applied from individual knapsacks — paraquat is a highly toxic agent when ingested and can also cause severe burns if it contacts the skin,<sup>6</sup> which is aggravated by the practice of having workers fill their knapsacks with the liquid herbicide mixture after they have already placed the knapsacks on their backs, resulting in frequent spillage and skin contact; (iii) constituents of fertilisers such as urea are substantial irritants of the eyes and respiratory tract; (iv) some farms use human 'spotters' to mark rows for aerial spraying of supposedly lower-toxicity herbicides and growth stimulants, resulting in very high skin and inhalational exposures; (v) smoke exposure is a frequent occurrence both because the planned burning of cane fields is part of the harvest process and because of the need to control accidental fires; and (vi) finally, very high exposures to relatively inert dusts may result in eye and respiratory irritation.

The importance of chemical, smoke and dust exposures is reflected in the very high complaint levels shown in Table III, with over 75% of participants reporting eye problems, upper respiratory problems and, in particular, lower respiratory problems. Reports of lower respiratory problems are of particular concern, as cough, phlegm production, shortness of breath and wheezing may be precursors or indicators of chronic lung disease. Some interesting patterns of risk factors for health outcomes associated with specific jobs are indicated in Table V. Firstly, these problems are more likely to occur when workers are required to perform jobs such as applying fertiliser on windy days, presumably resulting in increased skin contact and inhalation. The same is true of smoke inhalation and skin burns when participating in planned fires on windy days. It is notable that while the use of a mask or respirator decreases the likelihood of chest or breathing problems when participating in a planned burning, it increases the risk of eye problems or nose or throat problems, presumably because it allows the worker to enter an area with higher smoke concentrations. The same reasoning most likely explains the extremely high risk of chest or breathing problems associated with wearing special clothing when participating in a planned fire.

On the basis of the survey results as well as anecdotal information provided by shop stewards and others (S Kumalo, personal communication), it appears that worker health and safety training on these hazards is grossly inadequate. Previous studies of agricultural workers in South Africa have reported similar patterns of limited worker training in the safe use of chemicals.<sup>7</sup> These same sources asserted that workers were given no right to refuse dangerous work, and that in fact a worker attempting to do so would run the risk of physical assault. They also stated that workers' compensation claims are almost never filed, even in cases of acute injury, partly because many workers are on a contract basis and employers generally do not register them, and partly because of lack of knowledge on the part of workers. Other employment opportunities were described as being extremely limited, which may partly explain worker tolerance of unsafe and abusive conditions.

**Exposure to the elements.** Participants reported that in general they were required to work without regard to the weather, which meant working through the hottest part of the day and working in rainy and cold conditions. It should also be noted that during the entire work day no solid food or drinking water was available. Workers carried containers of *mahewu*, a fermented sugar cane drink, to the fields for hydration and sustenance. Inadequate hydration and nutrition during the work day has long been recognised as a health risk among KwaZulu-Natal sugar cane workers.<sup>8</sup>

**Inadequate medical care.** Items to do with adequacy of medical care were not included in the survey instrument. However, during the 2-day session shop stewards concurred that employers did not recognise sick notes from the worker's own doctor and that the doctors and nurses employed by the owner frequently sent participants back to work while they were still ill or injured, thus increasing the likelihood of aggravation or prolongation of their health problem. Workers who refused to return to work were often dismissed and required to leave the farm.

**Physical and psychological abuse and stress.** As shown in Table III, 14% of participants reported being struck with the fist or hand, or being pushed, shoved or kicked by a farm-owner or his agents; 9% reported being struck with an object, whipped, or attacked or threatened with a knife or gun by one of these same individuals in the past year. These behaviours appeared to be widespread, the former being reported by at least one individual on each of the seven farms, and the latter on six of the seven farms. Such actions represent gross violations of human rights and contravene the Bill of Human Rights in the South African Constitution. The level of abuse and psychological stress to which sugar cane workers are subjected can be further appreciated in the light of additional information provided by the shop stewards during the 2-day session. Firstly, it was reported that a typical infraction for which a worker would receive a beating from a manager or supervisor was the accidental breakage of a bag of fertiliser or



chemicals.<sup>5</sup> Secondly, it was reported that in the case of a fight between two workers, a manager or supervisor would sometimes administer 'justice' by beating a worker with a stick or whipping the worker. Thirdly, shop stewards reported three cases of which they were aware in which an owner or supervisor of a cane farm allegedly murdered a worker, and the local judicial authorities took no action. When one considers this information, together with the fact that many cane workers are working hundreds of kilometres from their usual place of residence, that they live on the owner's property in owner-provided housing, and that they depend on the owner for their food and medical care, the potential for severe abuse of human rights can be appreciated. Previous studies have compiled case reports and investigated the roots of violence against farm workers in South Africa.<sup>13</sup> However, this is the first study to provide population-based data on the reported incidence of these violent acts. These data indicate that these are not isolated, rare events.

It is important to consider why these agricultural workers, though unionised, would have experienced such reportedly serious occupational hazards, poor living conditions and physical threats and assaults by supervisors and managers. It would appear that geographical isolation, and the level of control exercised by farm owners over almost every aspect of workers' lives, are important elements. Perhaps also critical is the lack of legal protection for agricultural workers. In 1993, neither the then-existent occupational health and safety legislation, nor the labour relations legislation, covered the agricultural sector.

### STRENGTHS AND LIMITATIONS

A strength of the current study is its use of relatively unusual methodology to construct a survey instrument and collect data, which may have resulted in a particularly accurate and exhaustive identification of both occupational and non-occupational problems of concern to sugar cane workers. The methodology involved engaging shop stewards with direct knowledge and experience of working conditions and hazards in discussions to uncover information in a systematic fashion. By developing a process flow for growing and harvesting sugar cane and then breaking this flow down into individual work steps, focusing on hazards associated with each of these steps, an exhaustive and comprehensive look at problems was ensured. This type of participatory research in occupational health is being used with increasing frequency 'to expose unrecognised levels of work related illness, to study subjective symptoms in an effective way, to measure exposure and outcomes without high cost technology/skills, [and] to increase worker capacity and involvement. . .'.<sup>9</sup>

This study also has some notable limitations. Firstly, field conditions made it difficult to eliminate the potential for selection bias and ensure quality control in the administration

of interviews. Field conditions included the geographical dispersal of participants on several farms, the relatively low rate of literacy, the need to translate questionnaires into the local language, time pressure to complete interviews before the end of the growing season, and inability to obtain permission from most employers for the investigators to go on site. Investigators had the opportunity to conduct only one day of training for the shop stewards who actually administered interviews on the farms. Relative lack of interviewer training and the literacy problem were partially overcome by constructing survey instruments involving simple yes/no choices. Additionally, logic checks conducted on the return questionnaires indicated that most interviews had been conducted and recorded properly. As discussed under 'Results', a participation rate of 42% was achieved on the five farms where information was available. Thus there is at least the potential for substantial selection bias. Because of logistical difficulties, we were unable to collect systematic information on non-respondents. However, anecdotal information from the shop stewards conducting interviews indicates that there was a very low refusal rate. Rather, many union members could not be interviewed in the relatively short time span before the end of the growing season. This means that substantial selection bias is less likely. Even if one were to assume that the remaining 58% of the union members would have reported no work-related health problems, the incidence of complaints over the past 12 months for many of the general and job-specific health problems would still be quite high. For example, reports of lost work days as a result of injuries incurred riding to or from the sugar cane fields would still be close to 10%.

Another weakness of this study design is that it is based entirely on self-report, i.e. no objective measures such as physical examinations, review of medical records, measure of serum anticholinesterase levels, etc. were used. This, of course, would not have been feasible given the limited time and resources available. Moreover, the intention of this study was to develop a broad overview of occupational health problems among sugar cane workers, in part to indicate a path for future, more focused studies. In fact, we believe that the conduct of this study carries an important lesson, namely that quite comprehensive data on occupational health hazards can be collected quickly through survey instruments under relatively difficult field circumstances, and that the quality of this information renders it useful for planning future interventions and studies aimed at improving conditions in this work force.

An additional concern raised by the high reported frequencies of many of the health problems is the possibility of positive reporting or recording bias. To examine this issue, several additional analyses were undertaken. Firstly, for each participant, the overall percentage of positive responses to the 26 general health questions was calculated to detect any unusual distributions. Across all participants the positive percentage approximated a normal distribution with the mode



in the 50 - 70% positive region. Less than 3% of participants responded positively to more than 90% of the questions. Secondly, the percentages reported for various health complaints were examined stratified by farm, and within farm were stratified by specific interviewer to detect any unusual patterns. No interviewer failed to show substantial variation in frequencies of positive responses across different questions, or systematically recorded either higher or lower frequencies of positive responses than other interviewers on the same farm. However, on three isolated questions, a single interviewer on one farm, who interviewed a total of 46 participants, recorded positive frequencies grossly different from other interviewers on the same farm (and on other farms). This interviewer reported a frequency of 2.2% for skin burns versus 27.7% for other interviewers on this farm, 88.2% for being crushed or trapped by machinery versus 13.9% for other interviewers on this farm, and 90.1% for being struck, shoved or kicked by the owner or manager, versus 5.5% for other interviewers on this farm. If the records completed by this interviewer are excluded, the overall prevalence of positive responses to this last question drops from 14.0% to 9.5%. The same exclusion leaves the overall prevalence of being struck with an object, whipped, or attacked or threatened with a knife or gun by one of these same individuals virtually unchanged (from 9.2% to 9.1%). Thirdly, the percentage reporting the use of control measures associated with specific jobs, e.g. employer provision of rubber gloves when preparing or applying herbicides, were examined stratified by farm and interviewer. While substantial variation was present in the percentage of positive responses when comparing between farms, the degree of variation in response to this type of question between interviewers on the same farm was small. These analyses suggest that, on the whole, serious recording or reporting bias is not present. Lastly, even if there was very substantial over-reporting of health problems, say in the order of 100%, the true incidence of complaints over the past 12 months for many of the general and job-specific health problems would still be quite high.

## RECOMMENDATIONS

Because of the large number of problems reported, it would be necessary to prioritise hazards to be addressed on the basis of their severity, number of workers affected, and the ease with which they can be ameliorated. Addressing the list of priority hazards as detailed by the shop stewards during the 2-day meeting would be an important starting point. This list includes allowing tractor drivers to work alone in the field, lack of soap and water to wash hands with when using poison and chemicals, a number of hazards associated with controlling accidental fires, including lack of assessment as to whether an individual is fit to fight a fire, electrocution hazard when electricity poles are ignited, and the expectation that individuals who fought a fire during the night will work the

next day, leading to increased risk of fatigue-related accidents. Other hazards include those associated with climate such as reaping cane on hot days and working in the rain without protection, lack of worker say as to whether they are fit to work or not, risk of lightning strike when working in the fields, injuries associated with the off-loading of fertiliser, burning fields on windy days, and the lack of working toilets. Shop stewards recommended that drivers be given conductors, that soap be supplied as well as medication for chemical burns, that if woken at night to fight a fire workers should not be required to go to work the next day, that specially designated people deal with accidental fires and that they be given protective clothing, that no work take place during the hottest part of the day or on rainy days, that workers be allowed to visit general practitioners and that management recognise sick certificates from these practitioners, and that stacking of fertiliser piles should be limited to waist level, with loading and off-loading not to be done by females. It will also be important to study alternative work methods and successful practices used on other farms in South Africa and other countries, and to consider incorporation of these practices so that hazards may be minimised.

In addition to the recommendations put forward by the shop stewards, a non-exhaustive list of other recommendations includes the following:

1. Improvement in basic living conditions for workers in employer-owned housing, including provision of working toilets, indoor plumbing, electricity, indoor cooking facilities, mattresses and sheets, relief from overcrowding and worker choice as to whether to live with family.
2. Increased pay to reflect a minimum living wage.
3. Cessation of all physical abuse of workers by owners and their representatives. This may require a co-ordinated effort of education, enforcement, and prosecution of violators.
4. Education of all workers, supervisors and management regarding the types of health and safety hazards present in sugar cane farming, the recognition of these hazards in specific job situations, and safe work practices to reduce these hazards.
5. Changes in work processes, where feasible, to reduce or eliminate key hazards. Examples of this might include automation of particularly hazardous processes and redesign to ameliorate ergonomic hazards.
6. Provision of appropriate personal protective equipment at the employer's expense, including masks or respirators, gloves, boots, overalls, and rainsuits as appropriate, along with proper selection, training in use, and maintenance.
7. Routine inspection and maintenance of equipment. An example of this would be routine inspection of cables and chains used in baling, and their replacement at any sign of wear.
8. No application of fertiliser, pesticides or herbicides or starting of planned fires on windy days.
9. Redesigned lighter knapsacks for application of herbicides

and fertiliser. These knapsacks must be filled before placement upon the back of the worker. Spray equipment must be properly maintained.

10. Strategies to reduce pesticide use, such as Integrated Pest Management, should be considered.

11. Increased break time and increased job rotation for particularly labour-intensive jobs associated with physical injury and stress.

12. Workers to be encouraged to take time to work safely and carefully rather than meeting high production quotas.

13. Transport vehicles to have seats, seat belts, roofs and sides offering protection against rollover; separate storage of chemicals for transport to the field; storage place for bush knives during transport; no boarding of moving vehicles allowed.

14. The right to refuse dangerous work.

15. Improved access to impartial health care.

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#### References

1. Segal L. A brutal harvest — the roots of legitimization of violence on farms in South Africa. In: Segal L, ed. *The Project for the Study of Violence*. Johannesburg: Black Sash, 1990: 1-36.
2. Davies W. *We Cry For Our Land*. Oxford: Oxfam, 1990; 1-61.
3. Schoeman B, Plater T. Assaults on farm workers — must they go on and on? *Civil Rights League Newsletter* 1992; **39**: 4-10.
4. Nordstrom DL, Layde PM, Olson KA, Stueland D, Brand L, Follen MA. Incidence of farm-work-related acute injury in a defined population. *Am J Ind Med* 1995; **28**: 551-564.
5. Lee T-Y, Goodwin SG, Gibson RW, Carr WP, Shutske J, Renier CM. A population-based study of tractor-related injuries: regional rural injury study-I (RRIS-I). *J Occup Environ Health* 1996; **38**: 782-793.
6. Van Wendel de Joode BN, De Graaf IAM, Wesseling C, Kromhout H. Paraquat exposure of knapsack spray operators on banana plantations in Costa Rica. *Int J Occup Environ Health* 1996; **2**: 294-304.
7. London L. Agricultural safety practices on farms in the Western Cape. *S Afr Med J* 1994; **84**(5): 273-278.
8. Campbell GD. A 'five-point plan' for improving and maintaining health of farm workers and for increasing work output. *The South African Sugar Journal* 1974; **58**: 437-442.
9. Loewenson R. Participatory approaches in occupational health research. Paper presented at the 25th International Congress on Occupational Health, Stockholm, Sweden, 1996; 73-79.