Health effects due to pesticide exposure amongst rural women in Western Cape

Final Report to Women on Farms

PI: Dr MA Dalvie

Co-investigators: Prof. MF Jeebhay, Prof L London, Dr HA Rother

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Research conducted and report compiled by

Dr MA Dalvie

Centre for Occupational and Environmental Health Research, University of Cape Town

Health Sciences Faculty

University of Cape Town

Anzio Road

Observatory 7925

SOUTH AFRICA

On behalf of Centre for Rural Legal Studies and Women on Farms Project

Women on Farms Project

Four Oaks Building

Cnr Bird and Molteno Street

Stellenbosch 7600

PO Box 530

Stellenbosch 7599

REPORT SUMMARY

BACKGROUND

The Women on Farms Project (WFP), an NGO working with farm worker women in the Western Cape, identified reports in 2008 of health problems amongst farm worker women and their children including skin rashes, asthma, and other respiratory ailments. These reports are consistent with the literature on health hazards in agriculture. Many of the farms from which these reports of ill-health have emerged include farms supplying supermarket chains in the United Kingdom as part of an Ethical Trade programme, which provides preferential access to farm produce to producers who comply with best practice benchmarks on their farms. There are about 200 farms in the Western Cape supplying the UK supermarket chain TESCO through the Wine Industry Ethical Trade Association (WIETA) with whom WFP interacts. Given their membership of an international fair trade system, there are significant opportunities to address and improve the health situation facing women workers on these farms. WFP commissioned the School of Public Health and Family Medicine to conduct a study to better characterise the nature of the occupational health problems faced by women workers on these farms. This report is seen as the first Phase of a longer term project to inform further interventions and further research to address the problems identified.

HYPOTHESIS

The hypothesis of the study was that the pesticides to which women on farms in the Western Cape are exposed to, causes cholinesterase depression, poisonings, effects on the nervous system and asthma.

AIM

To investigate pesticide exposures experienced at work and from the environment and health effects resulting from these exposures amongst women residents on farms in the Western Cape.

OBJECTIVES

The research objectives include:

i) To determine the demographic and socio-economic factors of participants that may impact on pesticide exposures.
ii) To determine pesticide exposures experienced by women in all the jobs they worked and at all the places they lived.
iii) To measure red cell cholinesterase levels and pesticide residues in urine samples to be stored for further analyses in Phase 2 (due to a limited budget in Phase1) in order to validate domestic environmental and occupational exposures.
iv) To measure acute as well as long-term health effects associated with pesticide exposure with specific reference to respiratory allergy and asthma, neurotoxic and reproductive health end-points amongst participants
v) To measure confounders (factors causing health effects amongst the woman other than pesticides for eg. smoking, age and alcohol intake) that may affect the relationship between exposure and health effects.
vi) To investigate the relationship between health end-points and pesticide exposure controlling for relevant confounders

The process objectives include:

i) Providing a Situation Analysis for WFP to use for advocacy work
ii) Providing a basis for a more detailed exposure study to test different methods to reduce exposures
iii) Providing a base for addressing other health problems faced by farm worker women, such as access to sexual and reproductive health services.

METHODS

A cross-sectional study of 211 women including 121 women living and working on farms (Exposed Group) and 90 women living in towns (Unexposed Group) from Stellenbosch, Ceres, Paarl, Grabouw and Worcester in the rural Western Cape was conducted. Due to time-constraints and logistical difficulties, a non-random sample of participants were selected. A questionnaire with items on demographic, socio-economic factors, living history and environmental exposure to pesticides, job history, household pesticide exposure, medical history, alcohol consumption and smoking history, previous pesticide poisoning, acute pesticide health effects and incorporated standardised and validated instruments for identifying long-term health effects including respiratory health and asthma (European Community Respiratory Health Survey questionnaire), neurotoxicity (Q16), and reproduction was administered to participants. Additional tests included blood erythrocyte acetylcholinesterase (AChE), blood allergy tests (phadiotop and house dust mite, spider mite and storage mite -specific serum IgE levels) and fractional exhaled nitric oxide (FE_{NO}) measuring airway inflammation as a marker for asthma.

RESULTS AND DISCUSSION

Table I provides a summary of the study results by comparing the Exposed and Unexposed groups in terms their characteristics and health. The two groups were compared statistically for each characteristic and an "*" indicates when the two groups are statistically different.

Table II compares the average FE_{NO} in the Low Cholinesterase (indicative of high pesticide exposure) and Normal Cholinesterse groups and also the number and percentage of persons in the two groups that had FE_{NO} levels > 25 ppb and 50 ppb. The two groups were compared statistically and an "*" indicates that the two groups are statistically different.

The women from the Exposed Group were comparable those in the Unexposed Group with respect to education and socio-economic factors, but smoking and alcohol consumption was higher and the average age lower amongst the women in the Exposed Group (Table I). Results were adjusted for age, smoking and alcohol consumption where appropriate.

Table I Summary of results comparing Exposed to Unexposed groups

Variable	**Exposed Group (n = 121)**	**Unexposed Group (n = 90)**
Mean age (years)	34.8 ± 10.6	40.9 ± 1.4
Smoked > 1 year in life* (n, %)	70(58)	36(40)
Ever consumed alcohol*(n,%)	79(65)	39(43)
Use pesticides at home (n, %)	67(55)	56 (62.2)
Pesticide poisoning confirmed by a doctor (n, %)	6(5.0)	1 (1.1)
Mean cholinesterase (IU/L) Low cholinesterase (n, %)	6987.6 ± 859.2 14(12)	7207.3 ± 890.6 4 (4.7)
Total Q16 score (median, range)*	7 (0-16)	2.5 (0-15)
Highest asthmatic symptom reported: Have you been woken by coughing attack in last ye time (n, %)*	48(40)	22 (24.4)
Lifetime doctor diagnosed asthma	12(10)	12 (13.3)
FE_{NO}> 50ppb (n,%)	7(6)	8 (9.2)
Phadiotop sensitisation indicative of general allergy (n ,%)	46(38)	44 (51.2)
* P < 0.05 when comparing Exposed Group to Unexposed Group		

Table II: Fractional exhaled nitric oxide levels (FE_{NO}) amongst women with low cholinesterase and normal cholinesterase levsl

	Low Cholinesterase (n = 18)	Normal Cholinesterse (n = 186)
FE_{NO} summary data		
FE_{NO} ppb (median, range)*	11.7 (5.3-76.7)	10.0 (4-111.7)
FE_{NO} > 25ppb (n,%)	5 (27.5)	33 (17.7)
FE_{NO}> 50ppb (n,%) – clinical asthma	3 (16.7)	12 (6.5)
* P < 0.05 comparing Low Cholinesterase to Normal Cholinesterase group		

The study found that the cholinesterase levels amongst "women in the Exposed Group to be lower than those in the Unexposed Group (Table I). Household pesticide use amongst women in the Exposed Group was similar to those in the Unexposed Group and therefore the lower cholinesterase levels in the former group is indicative of higher exposures to pesticides which depress cholinesterase levels.

Women who live or work on a farm experience poisoning episodes. This result is consistent with anecdotes and reports by WFP amongst farm inhabitants.

There were more women in the Exposed Group compared to the Unexposed Group who reported neurological symptoms as measured by the Q16 questionnaire and this finding is consistent with that found in the literature.

These results (Table I) also demonstrated that more women exposed to pesticides on farms reported asthmatic respiratory and skin symptoms than those living in towns and that work-related symptoms are more common in this latter group especially when conducting outdoor work in the orchards. These results are consistent with previous studies in other setting that have shown a high prevalence of these symptoms amongst farm workers. Although, the proportion of women with self reported doctor diagnosed asthma was greater in the group of women living in towns, women with low cholinesterase levels (which is indicative of high pesticide exposure) were 5 times more likely to have elevated FE_{NO} levels (found in asthma) than those with normal cholinesterase levels (Table II). The percentage of women with allergy to mites was more in the group of women living in towns. Overall the results therefore indicate that the asthma symptoms reported by the women exposed to pesticides are not related to allergens but the asthma is more likely to be caused by the irritant effect of pesticides. There is evidence of non allergic asthma due to pesticides that has been reported in the literature.

The farm residents are exposed to pesticides in the environment in number of ways. For instance the average distance of homes from the spraying area was 10 m, the median number of days of spraying reported was 96 days, about a third reported that pesticides comes into house, farm residents use unprotected water sources for drinking and recreation, the use of empty pesticide use for recreational use including drinking water was reported and the washing of pesticide contaminated clothing at home was also reported. Tractor with a boom, which produces a substantial amount of drift, was reported by virtually all farm workers and "farm dwellers". The percentage of farm workers (10%) that reported the use of empty containers for drinking purposes is higher than that found in previous studies amongst these communities and is an issue that needs to be particularly addressed.

Regarding health and safety on farms, it is a major concern that that a high percentage of workers return to sprayed fields on the same day. Additionally nearly a quarter of farm workers reported that PPE are not provided, more than a third reported that there are no showers on the farm and nearly half reported that pesticide contaminated clothing is washed at home. The provision of PPE and adequate washing facilities is a requirement in terms of the Hazardous Chemical Substances Regulations. With less than half of farm workers unionized, unionization could address health and safety and other concerns of farm workers.

Although only 4 women in the study sample were applicators, it was reported that women worked as pesticide applicators in nearly 20% of farms. This is an issue for fair trade policy on gender .

Only 4 women in the study sample were applicators, but it was reported that women worked as pesticide applicators in nearly 20% of farms.

Access to most reproductive health services especially to state hospitals was reported by most (77-100%) participants. However, access to services for sexually transmitted diseases is a major concern as less than half of the participants reported access to these services. The study did not evaluate quality of reproductive health services.

CONCLUSIONS AND RECOMMENDATIONS

The study found depressed cholinesterase levels amongst women working and living on farms in the Western Cape. This indicates that they are highly exposed to pesticides at their work and in their homes. The women living and working on farms thus absorb a lot of pesticides leading to a drop in their cholinesterase levels. These high pesticide exposures make them prone to health effects associated with these pesticides. Evidence of health effects due to pesticide exposure found in the study was the elevated levels of self-reported acute health effects, self-reported neurological symptoms and asthmatic and skin symptoms amongst the women working and living on the farms. Additionally, more women with low cholinesterase levels (indicating that they are highly exposed to pesticides) had elevated FE_{NO} levels indicating the presence of lung inflammation associated with asthma compared to women with normal cholinesterase levels. This suggests that the asthma symptoms reported by the workers are more likely to be related to the irritant rather than allergic effects of pesticides on the lung.

A number of health and safety issues as well as labour issues need to be addressed on farms to reduce pesticide exposures of women. The high pesticide exposures call for tighter regulation of pesticide spraying and also tighter regulation in the sale of pesticides. Toxic release and use inventories on farms should be documented regularly. Education of farmers, farm management and farm workers on the use of pesticides and their environmental and health effects is vitally important. There is also a need for the implementation of integrated pest management methods.

Although the women reported access to most reproductive health services especially to state hospitals, access to services for sexually transmitted diseases is a major concern.

Further detailed study of the pesticide exposures amongst these women and the resulting health effects are required.

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DETAILED REPORT

1. Background

Agriculture is one of the most important income generating activities and the fifth biggest employer in South Africa (Heeren, Tyler & Mandeya 2003). Recent data has shown that approximately a tenth of the economically active population was employed in the agricultural sector in South Africa (Heeren, Tyler & Mandeya 2003). Pesticide usage in South African agriculture is the highest in the region and is increasing (Naidoo & Buckley, 2003). The Western Cape is one of the most agriculturally productive provinces in the country and focuses on agriculture as an important industry and income earner. Crop farming in the form of grapes, pome fruit, stone fruit, potato and wheat farming is especially important. Recent data (Dalvie et al. 2009) has shown that that the amount of pesticides sold to 5 major crop sectors pesticide sales in South African agriculture increased from 5400 tons in 1994 to over 6800 tons in 1999.

Women farm workers are at particular risk from occupational and environmental hazards in agriculture (Forastieri, 1999; McCoy et al, 2002; Naidoo et.al, 2010). This is the case even when women are not employed in tasks perceived to be high risk, as has been argued to be the case for hazards from pesticides (London et al, 2002). To compound the problem of occupational and environmental hazards, farm workers face multiple other social and biological hazards related to rural life, the social organisation of work and the problems of rural under-development worldwide (London, 1998). In South Africa, these contextual factors are even more challenging with high rates of rural poverty, under-development and lack of access to basic services inherited from apartheid (London et al, 1998a). In the Western Cape, women in farming communities are additionally exposed to social stressors related to widespread alcohol abuse and violence (London et al, 1998b), partly the legacy of the dop system whereby workers were given part payment in the form of alcohol.

The Women on Farms Project (WFP), an NGO working with farm worker women in the Western Cape, identified reports in 2008 of health problems amongst farm worker women and their children including skin rashes, asthma, and other respiratory ailments (Bowers et al, 2009). These reports are consistent with the literature on health hazards in agriculture (Stellman 1998; Forastieri, 1999, Dalvie et al, 1999) including studies in the Western Cape that have identified pesticides (Innes et al 1990; Dalvie et al 1999) and respiratory allergy to spider mite as an additional cause of asthma amongst farm workers (Jeebhay et al, 2007). It has increasingly been demonstrated over the last decade that some environmental chemicals do not only have direct irritant effects but also act as endocrine disruptors, directly affecting the immune system (Chalubinski et al, 2006). EDs can influence synthesis of cytokines, immunoglobulins, and cell mediators as well as immune cell activation and survival. Modulation by EDs of interleukin-4 production, Th1/Th2 balance and IgE production enable them to have a potential effect on allergic immune responses. A number of studies among workers exposed to pesticides in vineyards and orchard workers in the international literature demonstrate an increased prevalence of respiratory symptoms including asthma associated with decrements in lung function (Hoppin et al, 2002, Innes et al, 1990, Dalvie et al, 1999, Zuskin et al, 1997, Senthilselvan et al, 1992, Mekonnen et al, 2002, Zhang et al, 2002, Hoppin etal, 2009). In South Africa, a study conducted in the Western Cape provided evidence that increased risk of spider mite allergy to be related to high pesticide exposure among crop sprayers (Jeebhay 2007) and that organophosphates could have a role in the development of allergic sensitisation (Chatzi et al, 2006).

Though not amongst the complaints reported by farm women, there is evidence in the literature of other possible adverse effects of pesticide exposure on the health of women aside from allergic respiratory disease. Some of the most commonly used pesticides in the Western Cape as identified in previous surveys (London & Myers 1995; London et. Al. 2000, Dalvie etal, 2009) have been shown to have the potential to adversely affect human health. These include mental health impacts, neurobehavioural performance and reproductive health effects (Dalvie, 2009).

In addition to workplace tasks that place women at risk (such as mixing or applying pesticides), there are several mechanisms through which women and their children may be exposed to pesticides indirectly, including spray drift at work and into homes on the farm, re-entry into sprayed fields, washing of contaminated overalls at home, contamination of rural water sources and reuse of pesticide containers (London, 1994; London, 1998; Dalvie et al, 2003, Dalvie et al, 2004). A national study suggested that indirect pathways were a common route of exposure for children in homes in both urban and rural areas (Tolosana et al, 2009). There is also the problem of unwanted pesticides on farms (Dalvie et al, 2001 & 2006). Lack of knowledge about hazards and how to protect one self and one's family a major factor excerbating risk. For example, farm residents often are not aware of or familiar with pesticide labels, nor are they able to interpret the information meaningfully (Rother, 2008).

A previous study conducted in the Western Cape, indicated widespread low-level contamination of ground water, surface water and drinking water sources by endosulfan with about a third of the samples exceeding the European Drinking Water Standard of 0.1 µg/L. Other pesticides detected included, chlorpyrifos, azinphos-methyl, fenarimol, iprodione, deltamethrin, penconazole and prothiofos (Dalvie et al. 2003). Pesticide residues are also present in South African food. For instance, a study conducted by Dalvie &

London (2009) found pesticide residues in both local and imported wheat samples. Eight different agents were detected in total, multiple pesticides (> 1 pesticide) were detected in more than of 30% of samples and more than 10% exceeded the EU wheat MRL for permethrin. A recent study conducted in the Western Cape also showed that pesticide residues in the blood of farm workers, including female workers, to be very high compared to those measured in studies in other countries (Dalvie et al, 2009).

Many of the farms from which these reports of ill-health have emerged include farms supplying supermarket chains in the United Kingdom as part of an Ethical Trade programme, which provides preferential access to farm produce to producers who comply with best practice benchmarks on their farms. There are about 200 farms) in the Western Cape supplying the UK supermarket chain TESCO through the Wine Industry Ethical Trade Association (WIETA) with whom WFP interacts. Given their membership of an international fair trade system, there are significant opportunities to address and improve the health situation facing women workers on these farms. A study was therefore proposed to better characterise the nature of the occupational health problems faced by women workers on these farms. This report is seen as the first Phase of a longer term project to inform further interventions and further research to address the problems identified.

2. Hypothesis and Aim:

Hypothesis:

The hypothesis of the study was that the pesticides to which women on farms in the Western Cape are exposed to, causes cholinesterase depression, poisonings, effects on the nervous system and allergy-type asthma.

Aim:

To investigate occupational and environmental pesticide exposures and health effects resulting from these exposures amongst women residents on farms in the Western Cape.

3. Objectives

The research objectives include:

i) To determine the demographic and socio-economic factors of participants that may impact on pesticide exposures.
ii) To determine pesticide exposures experienced by women in all the jobs they worked and at all the places they lived.
iii) To measure red cell cholinesterase levels and pesticide residues in urine samples to be stored for further analyses in Phase 2 (due to a limited budget in Phase1) in order to validate domestic environmental and occupational exposures.
iv) To measure acute as well as long-term health effects associated with pesticide exposure with specific reference to respiratory allergy and asthma, neurotoxic and reproductive health end-points amongst participants
v) To measure confounders (factors causing health effects amongst the woman other than pesticides for e.g. smoking, age and alcohol intake) that may affect the relationship between exposure and health effects.
vi) To investigate the relationship between health end-points and pesticide exposure controlling for relevant confounders

The process objectives include:

i) Providing a Situation Analysis for WFP to use for advocacy work
ii) Providing a basis for a more detailed exposure study to test different methods to reduce exposures
iii) Providing a base for addressing other health problems faced by farm worker women, such as access to sexual and reproductive health services.

4. Methods

Study Design, Sampling and Population: A cross-sectional study of women farm residents in the rural Western Cape was conducted. The study sample was recruited by WFP who selected 211 women, 114 current living and working on a farm and 98 living in towns. The research team requested WFP to recruit women from farms affiliated to them located in the 5 most accessible Western Cape agricultural areas which included Stellenbosch, Ceres, Paarl, Grabouw and Worcester for the Exposure Group and for the Unexposed Group, women not living on farms from neighbouring towns in each area. About 40 women, 20 each from farms and towns, from each of the 5 areas were targeted. Due to time-constraints and logistical difficulties, a non-random sample of participants were selected. Farm residents were selected from the 5-10 most accessible farms in area and town residents from the most accessible houses in each area. One adult woman participant per household was be selected

Sample size calculations using a two sample-test of equality of means [Stata Corporation, 2003] (exposed/control ratio = 1, power = 80%, confidence level = 95%) and using the results from a recent study (Jeebhay, et al, 2007) shows that for a 30% change in IgE , 190 participants would be required.

Questionnaire: Trained interviewers administered questionnaires to women participants in their spoken language. The questionnaire (Appendix 1) contained items on demographic, socio-economic factors, living history and environmental exposure to pesticides, job history, household pesticide exposure, medical history, alcohol consumption and smoking history, previous pesticide poisoning, acute pesticide health effects and incorporated standardised and validated instruments for identifying long-term health effects including respiratory health and asthma (European Community Respiratory Health Survey questionnaire), neurotoxicity (Q16 (Axelson & Hogstedt, 1988), and reproduction (Time to pregnancy (Joffe et al, 1999).

Biological exposure indices: Erythrocyte acetylcholinesterase (AChE) and pesticide metabolites/residues.

A blood sample (9 ml) was drawn from each participant using a tube containing sodium heparin or EDTA as anticoagulant, by a qualified nurse. Spot urinary samples (50 ml) was collected from participants stored in field on dry ice and then transported to UCT, School of Public Health, where it was be stored at -20 degrees Celsius. The blood and urine samples are intended for pesticide analysis in Phase 2.

Allergy tests: Phadiotop and allergen-specific serum IgE levels

The blood sample (9 ml) was drawn from each participant using a Becton Dickinson Vacutainer SST tube (with gel medium and clot activator) by a qualified nurse. The blood was be allowed to clot for 1-2 hours at room temperature (20-24 degrees Celsius) and then centrifuged at 1350g for 10 minutes at room temperature. The serum was then transferred to another tube and stored at -20 degrees Celsius in a field freezer. The stored serum sample was transported on dry ice to the National Institute for Occupational Health, UCT where it was stored at -80 degrees Celcius until assayed for further measurement. The samples were sent to the NIOH Immunology laboratory for testing. Presence of sensitisation to common aeroallergens (house dust mites, grass pollens, cat, dog, cockroach etc.) was determined by the Phadiotop test. The quantification of specific IgE antibodies to house dust mite and specific occupational allergens (spider mite and storage mite) was performed using the UniCAP system (Phadia, Uppsala, Sweden).

Airway inflammation as a marker for asthma: Fractional exhaled nitric oxide (FE_{NO})

Fractional exhaled NO (FE_{NO}) was determined during single-breath exhalations (Appendix 2 & 3). The recommended technique for adult patients involves inhaling NO-free air via a mouthpiece until the lungs are filled, followed immediately by full exhalation at an even rate through the mouthpiece into the apparatus. A hand-held nitric oxide sampling device (NIOX MINO® Airway Inflammation Monitor (NIOX MINO);

Aerocrine AB, Solna, Sweden) was used. Under guidance of the nurse, all participants inhaled NO-free air to close to total lung capacity and exhale during 10 s at a flow rate of 50 ml/sec to provide three approved FE_{NO} measurements. The participant was seated comfortably, with the mouthpiece at the proper height and position. A nose clip was not used, because it might have affected the accuracy of the results. The participant inserted a mouthpiece and inhale over 2 to 3 seconds through the mouth to total lung capacity (TLC), or near TLC if TLC is difficult, and then exhaled immediately, because breath holding may affect FeNO. Three technically adequate measurements was performed in line with the current American Thoracic Society /European Respiratory Society recommendations [ATS/ERS 2005]. Exhaled nitric oxide (NO) test was done after hours during the working week. Special instructions was provided to workers to ensure that tested individuals do not smoke tobacco, eat or drink (at least 1 hour before) prior to the test. Ambient NO and temperature was also recorded.

Logistics

Fieldwork was conducted at the WFP premises during the period 24 October -3 December 2009. WFP arranged for the recruitment and transport of the participants on a daily basis.

A pilot study was conducted to test the questionnaire and to work out the logistics for the main study.

Data management and statistical analysis

Statistical analysis was performed using STATA version 9. Univariate analysis and bivariate analysis was mostly conducted with multi-variate analysis only for asthma outcomes and Q16 score. Multiple Linear Regression and Logistic Regression Analysis was used in multivariate analysis. Confounder variables used in models included age, smoking status (ever smoked for > 1 year) and atopy (Phadiotop > 0.35 ku/l) for asthma outcomes and age and alcohol consumption for Q16 score.

Ethics

The study was done in accordance with the Declaration of Helsinki of the 25th world Medical Assembly (WHO, 2000). The study proposal was sent to the University of Cape Town's Research Ethics Committee for approval (Reference 393/2009). Informed consent (Appendix 4) was obtained from participants. Confidentiality was preserved in that only the research team had access to the data and only group results was reported on. Feedback of individual results will be made to participants.

5. Results and Discussion

5.1 Participation

Two hundred and eleven women from 5 different towns in the Boland participated in the study. One hundred and thirteen women currently living on farms and 98 not living on farms were recruited by WFP. There were 8 of the women who did not live on a farm, but worked on a farm and they were included in the farm worker group. There were therefore 121 women who lived and/or worked on a farm and 90 who lived in a town. In this report the women from the farms will be referred to as the Exposed Group as they are the ones who are exposed to pesticides sprayed on farms. The women from the towns will be called the Unexposed Group as they are not exposed to the pesticides sprayed on the farms. The two groups will be compared to each other.

One hundred and thirty four (63.5%) participants lived on at least one other location, 38 (18%), on at least two other locations and 14 (6.6%) on at least 3 other locations. About twenty eight percent (n = 25) of the women in the Unexposed Group previously lived on a farm which means that they were exposed to pesticide spraying previously while 19% (n = 23) of the women in the Unexposed Group previously lived or worked in a town where they were not exposed to pesticide spraying on a farm. Additionally, 13 (14.4 %) women from the Unexposed Group were born on a farm and 83 (68.0%) of the women in the Exposed Group were born on a farm. This should be considered in the results when determining if health effects are caused by pesticides.

Table1 shows the distribution of participants from the 5 different areas. Grabouw had low numbers of women participants from towns.

5.2 General characteristics and non-pesticide exposures

Before comparing the Exposed Group to the Unexposed Group to determine if pesticides are causing health effects, we are need to determine if the two groups are similar in terms of their general characteristics and non-pesticide exposures as these characteristics and exposures might be responsible for any health effects seen. These characteristics and exposures include demographics, socio-economic factors, chronic health problems, lifestyle factors and domestic pesticide exposures.

5.2.1 Demographics, anthropometric characteristics, socio-economic factors and chronic health problems

Table 1-3 compares the number and percentage of persons in the Exposed and Unexposed groups in terms of their demographics, socio-economic factors and chronic health problems. The two groups were compared statistically for each characteristic and an "*" indicates when the two groups are statistically different.

Afrikaans was the predominant home language in both groups. The average age of the Unexposed Exposed Group (40.9 ± 1.4 years) was significantly ($p < 0.05$) higher than the average age of the Exposed Group (34.8 ± 10.6 years). The average weight of the Unexposed Exposed Group (71.9 ± 19.9 kg**)** was significantly ($p < 0.05$) higher than the average weight of the Exposed Group (63.3 ± 15.5 years) while the average height of the Unexposed Exposed Group (1.57 ± 0.06 m**)** was similar to the average height of the Exposed Group (1.54 ± 0.06 m) . All the women in the Exposed Group are currently working whereas most the women in the Unexposed Group (83%) were not working.

Educational status was similar in the two groups with more than 90 % of women in the two groups having attended school but less than 4 % matriculated and none received any tertiary education.

Household size was similarly high in the two exposure groups (mean = 4.9 ± 2.0 in the Unexposed Group, 5.4 ± 2.0 amongst Exposed Group). Socio-economic status as measured by household income (Median, Range, n: R 3030, R800-R 19000, 76 amongst Unexposed Group; R 2160, R 500-R 18080, 121 amongst Exposed Group) and ownership of home was higher amongst the Unexposed Group compared to the Exposed Group but possession of household appliances and occurrence of hunger was similar in the two groups. Support from family and grants were prevalent in all groups. The number of grants per household (average of one grant per household in both exposure groups) were similar in the two exposure groups.

Thirteen different chronic medical problems were reported. High blood pressure, (12.3%), hay fever (10.4%) and eczema (6.2%) were the most common problems. There were more women from the Unexposed Group had suffered from asthma. Both groups suffered from other medical problems at a similar rate.

Table 1: Demographic characteristics

Demographic characteristic	Exposed Group (n = 121)	Unexposed Group (n = 90)
Areas		
Ceres	23(19%)	19(21%)
Grabouw	35(29%)	3(3%)
Paarl	16(13%)	23(26%)
Stellenbosch	35(29%)	22(24%)
Worcestor	22(18%)	23(26%)
Home language		
English	0(0%)	1(1%)
Afrikaans	119(98%)	79(88%)
Isixhosa	2(2%)	10(11%)
Home location*		
Farm	113(93%)	0(0%)
Town	8(7%)	90(100%)
Working*		
Yes	101(83%)	25(28%)
No	20(17%)	65(72%)
Occupation:		
Farm workers*	97(80%)	0(0%)
Unemployed*	20(17%)	64(71%)
Domestic worker	4(3%)	1(1%)
Administrator	0(0%)	4(4%)
Self-employed	0(0%)	5(6%)
Factory worker	0(0%)	3(3%)
General worker	0(0%)	2(2%)
Pensioner	0(0%)	1(1%)
Other	0(0%)	7(8%)
Level of education		
No schooling	4(3%)	4 (4.4%)
Matriculated	1(1%)	3 (3.3 %)
Tertiary	0(0%)	0 (0.0 %)
* $P < 0.05$ when comparing Exposed to Unexposed Group		

Table 2 Socio-economic characteristics

Socio-economic factors	Exposed Group (n = 121)	Unexposed Group (n = 90)
Home ownership		
Property of farm owner*	103(85%)	0 (0.0)
Own property*	14(12%)	68(76%)
Rented *	3(3%)	22(24%)
Other	1(1%)	0(0%)
Income sources		
Work		
Yes	101(83%)	27(30%)
No	20(17%)	63(70%)
Spouse		
Yes	67(55%)	37(41%)
No	54(45%)	53(59%)
Parent		
Yes	30(25%)	19(21%)
No	91(75%)	71(79%)
Brother		
Yes	16(13%)	8(9%)
No	105(87%)	82(91%)
From children		
Yes	12(10%)	18(20%)
No	109(90%)	72(80%)
Child support grant		
Yes	40(33%)	15(17%)
No	81(67%)	75(83%)
Pension		
Yes	7(6%)	11(12%)
No	114(94%)	79(88%)
Disability grant		
Yes	3(3%)	12(13%)
No	118(98%)	78(87%)
Taking care of children		
Yes	0(0%)	0(0%)
No	121(100%)	90(100%)
Foster care		
Yes	3(3%)	3(3%)
No	118(98%)	87(97%)
Helping aid grant		
Yes	9(7%)	8(9%)
No	112(93%)	82(91%)
Compensation benefits		
Yes	0(0%)	0(0%)
No	121(100%)	90(100%)
Any grant		
Yes	60(50%)	41(45.6%)
No	61(50%)	49(45.6%)
Other		
Yes	8(7%)	8(9%)
No	113(93%)	82(91%)
Go hungry		
Never	101(83%)	71(79%)

Seldom	9(7%)	5(6%)
Sometimes	11(9%)	13(14%)
Often	0(0%)	1 (1%)
Content of home		
Electricity		
Yes	120(99%)	87(97%)
No	1(1%)	3(3%)
Radio		
Yes	99(82%)	72(80%)
No	22(18%)	18(20%)
Television		
Yes	109(90%)	83(92%)
No	12(10%)	7(8%)
Landline telephone		
Yes	17(14%)	24(27%)
No	104(86%)	66(73%)
Refrigerator		
Yes	100(83%)	77(86%)
No	21(17%)	13(14%)
Computer		
Yes	16(13%)	16(18%)
No	105(87%)	74(82%)
Washing machine		
Yes	81(67%)	60(67%)
No	40(33%)	30(33%)
Cellular phone		
Yes	105(87%)	81(90%)
No	16(13%	9(10%)
* P < 0.05 when comparing Exposed to Unexposed Group		

Table 3 Chronic Health Problems

	Exposed (n = 121)	**Unexposed (n = 90)**
Chronic Medical problems (n, %):		
Asthma	5(4.1)	7(7.8)
Bronchitis	1(1.0)	3(3.3)
TB	2(2.0)	0(0)
Eczema	8(7.0)	5 (5.6)
Hayfever	11(9.0)	11(11.1)
Farmers Lung	1(1.0)	0(0)
Arthritis	5(4.1)	4(4.4)
High blood pressure	15(12.4)	13(14.4)
Chronic stomach problems	1(1.0)	0(0)
Low blood pressure	3(2.5)	0(0)
Diabetes	2(2.0)	1(1.1)
Heart problems	2(2.0)	0(0)
Sinus	1(1.0)	0(0)
Ulcer	0(0)	1(1.1)
Odema	0(0)	1(1.0)
* P < 0.05 comparing Exposed to Unexposed Group		

The Unexposed Group was therefore comparable to the Exposed Group with respect to education and socio-economic factors, but the average age and weight was higher amongst the Unexposed Group. When comparing the health effects due to pesticides, all the results were adjusted for age and some for weight where applicable.

5.2.2 Lifestyle factors and domestic pesticide exposures

Table 1-3 compares the number and percentage of persons in the Exposed and Unexposed groups in terms of their lifestyle factors (smoking and alcohol intake) and domestic pesticide exposures. The two groups were compared statistically for each characteristic and an "*" indicates when the two groups are statistically different.

There were significantly more women in the Exposed Group that currently or ever smoked for more than 1 year in their lives and that inhaled or are exposed to smoke compared to women in the Unexposed Group. Intake of drugs reported by the women were low in both groups.

There were significantly more women in the Exposed Group that consume alcohol compared to women in the Unexposed Group.

Table 4 Lifestyle Factors

Lifestyle factor	**Exposed Group (n = 121)**	**Unexposed Group (n = 90)**
Cigarette smoking Smoked > 1 year in life* Currently smoke* Inhale smoke*	 70(58%) 69(57%) 80(66%)	 36(40%) 36(40) 41 (45.6)
Drugs intake	0(0%)	2(2%)
Consume alcohol*	79(65%)	39(43%)
* P < 0.05 when comparing farmworkers & farm dwellers to town dwellers		

More than half of the respondents in both exposure groups reported that pesticides are used at home. Pesticides used at home include Baygon, Die Roach, Doom spray, Doom powder for cockroaches, Jeyes fluid, Target, Raid and Sulphur (used in the garden on farms).

As can be expected, living with someone else in the house that use pesticides, washing pesticide contaminated clothing at home, washing it with the rest of the clothing and use of empty pesticide containers was common amongst women in the Exposed Group. On farms the use of empty pesticide containers for drinking was also prevalent.

Smoking and alcohol consumption was therefore higher amongst the Exposed Group. Thus when comparing the Unexposed to the Exposed Group to determine if pesticide exposure causes health effects, smoking and alcohol should be controlled for.

Table 5: Household pesticide use

	Exposed Group (n = 121)	Unexposed Group (n = 90)
Use pesticides at home	67(55.4%)	56 (62.2)
Anyone else in house that works with pesticides*	36(29.8%)	1 (1.1)
Pesticide contaminated clothing washed at home*	58(47.9%)	1 (1.1)
Clothing washed with rest of washing	39(32.2%)	0 (0.0)
Use empty containers at home*	13(10.7%)	0 (0.0)
Use empty containers at home for drinking*	10(8.3%)	0 (0.0)
* P –value < 0.05 comparing controls to farm workers and farm dwellers		

5.3 Health effects due to pesticides

5.3.1 Pesticide poisoning and puberty

This section deals with pesticide poisonings, symptoms of pesticide poisonings and puberty. We included these questions in this study in order to see if the women exposed to pesticides experience pesticide poisoning and to see if they reach puberty earlier or later than women not exposed to pesticides without the use of special medical equipment.

Table 6 compares the number and percentage of persons in the exposed and unexposed group that reported pesticide poisonings, symptoms of pesticide poisonings and their age of puberty. The two groups were compared statistically for each question and an "*" indicates when the two groups are statistically different.

The average age of puberty reported by women from the farms was similar to those from the towns. This result does not indicate that the pesticides sprayed on the farms are affecting the age at which women reaches puberty.

Four women suffered from pesticide poisoning once, 1 woman suffered from poisoning twice, and 1 woman suffered from poisoning on three occasions. Table 6 shows that all the pesticide poisoning symptoms were reported by both groups but more so in the Exposed Group. The percentage of women who reported poisoning symptoms in the Exposed Group was statistically higher than in the Unexposed group for all the symptoms. Age and alcohol intake are confounding variables; this means that they might have been responsible for the symptoms being reported. Therefore they were controlled in order to make the results more accurate and similar results were found when they were controlled.

These results indicate that women who live or work on a farm are exposed are exposed to high levels of pesticides which causes poisoning episodes amongst them. This result is consistent with anecdotes and reports by WFP amongst farm inhabitants.

Table 6: Pesticide poisoning and puberty

Pesticide poisoning symptom and age of puberty	**Exposed (n = 121)**	**Unexposed (n = 90)**
Average age at puberty (Mean ± standard deviation, years)	14.2 ± 1.7	14.2 ± 1.9
Poisoning , n (%):		
Did you ever experience pesticide poisoning that was confirmed by a doctor?	6(5.0%)	1(1.1%)
Do you frequently feel/have:		
Dizzy*	73(60.0%)	34(37.8)
Nauseas*	61(50.4%)	26(28.9)
Headaches*	93(77%)	50(55.6)
Skin, nose and/or eye irritation*	28(23.1%)	10(11.1)
Skin rashes*	35(29.0%)	10(11.1)
Nausea and vomiting*	33(27%)	10(11.1)
* P < 0.05 comparing Exposed to Unexposed Group		

5.3.2 Cholinesterase

Blood samples collected from the women were analysed for cholinesterase to indicate if they are exposed to pesticides. Certain pesticides lower the cholinesterase level in the body. A person with a low level of cholinesterase in their body is therefore highly exposed to pesticides and at risk of other medical conditions. A cholinesterase level below 6021 IU (low end of the laboratory range) is considered low and indicates that the person has been exposed reasonably highly to pesticides. The cholinesterase level can be standardized or corrected for the amount of haemoglobin in blood.

There was a wide range in cholinesterase levels measured amongst the women with the average = 7041 IU/L and range: 4014-9072 IU/L. The average cholinesterase level in the Exposed Group (6987.6 ± 859.2 IU/L, n = 120) was about 3% lower (p = 0.0761) than in the Unexposed Group (7207.3 ± 890.6 IU/L, n = 24). The average cholinesterase level standardized for haemoglobin amongst the Exposed Group (5452.6 ± 744.9 IU/g Hg, n = 24) was also lower (p = 0.1349) than the Unexposed Group (5604.3 ± 670.9 IU/g Hg, n = 24).

About 8.7 % cholinesterase levels (not standardized for haemoglobin) were low, with the percentage of low levels much higher (p = 0.079) amongst women in the Exposed Group (11.6%) compared to the women in the Unexposed Group(4.7%). The Odds Ratio for low cholinesterase levels amongst the Exposed Group compared to the Unexposed Group was 2.7 (CI: 0.86-8.50).

These results show that the women from the farms are exposed to high levels of pesticides that could effect their health. Household pesticides, that also decrease the cholinesterase level of a person, was similar in the two exposure groups indicating that it is the pesticides sprayed in the field that are responsible for decreasing the cholinesterase levels of the women from the farms. The results are consistent with a previous study conducted amongst rural residents living near cotton fields in Nicaragua (Kiefer et. al,1997). However, it should be noted that cholinesterase measurements are highly variable and that one should actually monitor the change in a person's cholinesterase levels during the non-spraying and spraying season. Also, less than 2% (n = 4) of the women were applicators which is lower than that found in our other local studies. If there were more women applicators then the decrease in cholinesterase levels could have been more.

5.3.3 Neurological symptoms (Q16)

The Q16 is a list of 16 questions dealing with easily observable health problems related to the nervous system. We included the Q16 in this study in order to see if pesticide exposure caused any health problems related to the nervous that people could observe and report without the use of special medical equipment. Table 7 compares the number and percentage of persons in the exposed and unexposed group that reported each health problems individually and as well as the average number of symptoms reported by persons in the two groups. The average number of symptoms is called "Total Score". The two groups were compared statistically for each symptom and for the total score. An "*" indicates when the two groups are statistically different.

Table 7 shows that all symptoms were reported by both groups but more so in the Exposed Group. Most women in both exposure groups reported headaches and abnormal exhaustion. Most of the individual symptoms and the average number of symptoms reported in the Exposed Group (average = 7 symptoms) were statistically higher than in the Unexposed Group (average = 2.5 symptoms). Age and alcohol intake are confounding variables; this means that they might have been responsible for the symptoms being reported. Therefore they were controlled in order to make the results more accurate and similar results were found when they were controlled.

These results indicate that the pesticides to which the women who live or work on a farm are exposed to, are causing them to report more neurological symptoms.

Farm workers' and farm residents' higher rates of self-reported neurological symptoms compared to town dwellers as measured by the Q16 questionnaire is consistent with 20 out of 24 previous studies that used symptom reporting to evaluate neurologic effects of pesticide exposure (Kamel and Hoppin 2004). The prevalences of these neurological symptoms measured in this study falls in at the high end of the spectrum of prevalences previously measured in these studies investigating their relationship to pesticide exposure and are also higher than that found amongst workers exposed to other neurotoxic chemicals (Lundberg et al, 1997, Nordling et al, 2007). The high neurological symptom prevalences are also consistent with local data collected by our research team. The Q-16 results indicate that pesticide exposure may cause or increase people's chances of experiencing a variety of neurotoxic health problems.

Therefore, farm owners need to implement policies that minimize workers' exposure to pesticides and educate workers on the dangers of pesticide exposure.

Table 7: Responses to Q16

Symptoms	**Exposed (n = 121)**	**Unexposed (n = 90)**
Are you abnormally tired? *	81(77.0)	37 (41.1)
Do you have palpitations of the heart when you do not exert yourself? *	60(50.0)	26 (28.9)
Do you often have painful tingling in some part of your body?*	55(45.5)	24 (26.7)
Do you often feel irritated without any particular reason? *	59(48.8)	22 (24.4)
Do you often feel depressed without any particular reason?*	62(51.2)	30 (33.3)
Do you often have problems concentrating?	34(28.1)	20 (22.2)
Do you have a short memory?*	59(48.8)	28 (31.1)

Do you often perspire without any particular reason?	30(24.8)	15 (16.7)
Do you have any problems with buttoning and unbuttoning?	6(5.0)	4 (4.4)
Do you generally find it hard to get the meaning from reading newspapers and books?	31(25.6)	16 (17.8)
Have your relatives told you that you have a short memory?	32(26.4)	18 (20)
Do you sometimes feel a heavy feeling on your chest?*	48(39.7)	17 (18.9)
Do you often have to make notes about what you must remember?*	36(29.8)	14 (15.6)
Do you often have to go back and check things you have done such as locking the door?*	64(52.9)	26 (28.9)
Do you have a headache at least once a week? *	105(86.8)	42 (46.7)
Do you think that you have less sex than most persons of your age?	53(43.8)	35 (38.9)
Total Score (median, range)*	7 (0-16)	2.5 (0-15)
* P < 0.05 comparing Exposed to Unexposed Group		

5.3.4 Asthma and skin effects caused by pesticides

This section reports on testing done to find out firstly if pesticides causes asthma and skin effects in the women who live and work on farms and secondly if the pesticides caused allergy amongst the exposed women that is leading to the asthma. The testing included an asthma and skin symptoms questionnaire, allergy testing in the blood of women and testing for lung inflammation caused asthma from the air the women breathed out.

5.3.4.1 Asthmatic and skin symptoms questionnaire

The asthmatic and skin symptoms questionnaire is a list of questions dealing with easily recognisable current asthma related symptoms in the past year, current and past asthma including those diagnosed by a doctor and asthma medication, hay fever and work-related eye-nose, asthma and skin symptoms. We included this questionnaire in this study in order to see if pesticide exposure caused asthma and asthmatic and skin symptoms that people could observe and report without the use of special medical equipment. Table 8 compares the number and percentage of persons in the Exposed and Unexposed group that reported each question. The two groups were compared statistically for each question and an "*" indicates that the two groups are statistically different.

Table 8 shows that 11% of women who participated in the study reported that they had asthma that was diagnosed by a doctor and 24% had reported hay fever. The percentage of women who had asthma that was diagnosed by a doctor was higher in the Unexposed group (13%) compared to the Exposed group (10%), and only 10% in the Unexposed Group received treatment compared to 3% in the Exposed Group. Meanwhile, hay fever was more common in the Exposed Group (28%) than it was in the Unexposed Group (21%). These results were not statistically different. Similarly, the percentage of women with current asthma related symptoms in the past year was consistently higher in the Exposed Group (16-40%) compared to the Unexposed Group (8-24%). Some of these results were statistically different as indicated in Table 8. Work-related eye-nose, asthma and skin symptoms were higher statistically in the Exposed Group compared to the Unexposed Group. The symptoms were three times more prevalent when working in the vineyard/orchard

than when working in the packing room. However, the percentage of women with asthma symptoms due to dust and other common allergens in the house was very similar in the two groups. Age and smoking are confounding variables; this means that they might have been responsible for the symptoms being reported. Therefore they were controlled in order to make the results more accurate and similar results were found when they were controlled.

Table 8: Respiratory and skin symptoms

Respiratory and skin symptoms	**Exposed Group (n = 121)**	**Unexposed Group (n = 90)**
Have you had wheezing or whistling in your chest at any time in the last 12 months? *	45(37.2)	20 (22.2)
Have you been short of breath when the wheezing noise was present?	33(27.3)	15 (16.7)
Have you had this wheezing or whistling when you did not have a cold or flu?	24(19.8)	14 (15.6)
Have you been woken up with a feeling of tightness in your chest at any time in the last 12 months?*	36(29.8)	9 (10)
Have you had an attack of shortness of breath that came on during the daytime were at rest at any time in the last 12 months?	20(16.5)	7 (7.8)
Have you been woken by an attack of coughing at any time in the last 12 months?*	48(39.7)	22 (24.4)
Have you ever had asthma?	11(9.1)	13 (14.4)
If yes, was this confirmed by a doctor?	12(9.9)	12 (13.3)
Have you had an attack of asthma in the last 12 months?	3(2.5)	1 (1.1)
Are you using any medicines, including inhalers/pumps, nebulizers, syrups or tablets, for asthma or breathing problems?	4(3.3)	8 (9.9)
When you are near animals, feather or in a dusty part of the house, do you ever get a feeling of tightness in your chest?	39(32.2)	23 (25.6)
Do you get a tight chest or wheeze when you work in the:		
Vineyard/Orchard *	36(29.8)	8 (8.9)
Packing room *	14(11.6)	2 (2.2)
Other	6(4.9)	3 (3.3)
Have you had any nasal allergies including hay fever or itchy and watery eyes/nose in the last 12 months?	31(25.6)	19 (21.1)
Do you get itchy/watery eyes or nose when you work in the:		
Vineyard/Orchard*	35(28.9)	1 (1.1)
Packing room *	21(17.4)	1 (1.1)
Other *	13(10.7)	3 (3.3)
Have you had any skin problems in the last 12 months?	38(31.4)	10 (11.1)

Do you get red, itchy pimples when you work in the:		
Vineyard/Orchard *	33(27.3)	3 (3.3)
Packing room*	11(9.1)	2 (2.2)
Other*	6(4.9)	2 (2.2)
* P < 0.05 comparing Exposed to Unexposed group		

5.3.4.2 Asthmatic airway inflammation (Fractional exhaled nitric oxide levels, FENO)

FE_{NO} was measured in order to assess if the women had inflammation in the airways of the lung that was caused by asthma. A person with a high FE_{NO} level has a greater chance of having asthma than a person with a low level. A FE_{NO} > 25 ppb is regarded as abnormally high while a FE_{NO} > 50 ppb indicates asthma is present.

Table 9a compares the average FE_{NO} in the Exposed and Unexposed groups and also the number and percentage of persons in the Exposed and Unexposed groups that had FE_{NO} levels > 25 ppb and 50 ppb. The two groups were compared statistically and an "*" indicates that the two groups are statistically different.

The average FE_{NO} level was significantly lower in the Exposed Group compared to the Unexposed Group. There was also a greater proportion of women from the Unexposed Group with an abnormal level of > 25ppb and > 50ppb indicative of asthma compared to Exposed Group. Age, weight, alcohol intake and general allergy (atopy) are confounding variables; this means that they might have been responsible for the effects on FE_{NO} levels. Therefore they were controlled in order to make the results more accurate and similar results were found when they were controlled. Similar results were also found when including the 25 women in the Unexposed Group who had previously lived on a farm in the Exposure Group. This is consistent with the data reported in the questionnaire where a higher percentage of women reported asthma diagnosed by a doctor.

Table 9a: Fractional exhaled nitric oxide levels (FE_{NO}) amongst Exposed and Unexposed groups

	Exposed Group (n = 120)	**Unexposed Group (n = 87)**
FE_{NO} summary data		
FE_{NO} ppb (median, range)*	9.1 (4-117.7)	12.3 (4-109)
FE_{NO} > 25ppb (n,%)	18 (15.0)	20 (23.0)
FE_{NO}> 50ppb (n,%)	7 (5.8)	8 (9.2)
* P < 0.05 comparing Exposed to Unexposed group		

Since these results were different to the prevalence of symptoms reported, we investigated the FE_{NO} results further by comparing the FE_{NO} levels amongst women with low cholinesterase levels (which indicates that they are highly exposed to pesticides) to the FE_{NO} levels amongst the rest of the women as we suspected that there may be an element of exposure misclassification as the women may not have recalled their exposures as accurately due to the changing nature of their work and home situation.

Table 9b compares the average FE_{NO} in the Low Cholinesterase and Normal Cholinesterse groups and also the number and percentage of persons in the two groups that had FE_{NO} levels > 25 ppb and 50 ppb. The two groups were compared statistically and an "*" indicates that the two groups are statistically different.

The average FE_{NO} level was lower in the Low Cholinesterase Group compared to the Normal Cholinesterase Group. There was also a greater proportion of women from the Low Cholinesterase Group with an abnormal

FE_{NO} level of > 25ppb and > 50ppb indicative of asthma compared to Normal Cholinesterase Group. Age, weight, alcohol intake, smoking and general allergy (atopy) are confounding variables; this means that they might have been responsible for the effects on FE_{NO} levels. Therefore they were controlled in order to make the results more accurate and these results show that the women in the Low Cholinesterase Group were 5 times (Odds Ratio = 5.2, 95% CI : 0.9-32.5, p=???) more likely to have an abnormal FE_{NO} level > 50ppb indicative of asthma than the Normal Cholinesterase group. This indicates that women who are highly exposed to pesticides are more likely to have asthma, which cannot be normally picked up on routine tests at a clinic.

Table 9b: Fractional exhaled nitric oxide levels (FENO) amongst women with low cholinesterase and normal cholinesterase levsl

	Low Cholinesterase (n = 18)	**Normal Cholinesterse (n = 186)**
FENO summary data		
FENO ppb (median, range)	11.7 (5.3-76.7)	10.0 (4-111.7)
FENO > 25ppb (n,%)	5 (27.5)	33 (17.7)
FENO> 50ppb (n,%)	3 (16.7)	12 (6.5)
* P < 0.05 comparing Low Cholinesterase to Normal Cholinesterase group		

5.3.4.3 Allergy tests (Serum-specific IgE levels)

Four allergy tests were performed on the blood samples obtained from the participating women including Phadiotop which indicates general allergy (or atopy), house dust mite, storage mite and spidermite. An IgE level of > 0.35 ku/l indicates that a person has allergy and is sensitised to the specific allergen.

Table 10 compares the average IgE (allergy level) in the Exposed and Unexposed groups and also the number and percentage of persons in the Exposed and Unexposed groups that were sensitized (IgE > 0.35 ku/l). The two groups were compared statistically and an "*" indicates that the two groups are statistically different.

The percentage of women with general allergy in both groups of women was very high (38 and 51%) as demonstrated by the positive phadiotop test. While the average IgE levels for the phadiotop was higher in the Unexposed group, the average levels of IgE to HDM (house dust mite. Dermatophagoides Pteronyssinus), spider mite (Tetranychus urticae) and storage mite (Lepidoglyphus destructor) were very similar among the women in the 2 exposure groups. However, the proportion of women sensitised to the domestic allergen (house dust mite) and the allergens at work (storage mite and spider mite) was higher in the Unexposed group than the Exposed group.

These results of the allergy tests show that the prevalence of allergy to common allergens and potential occupational allergens are not statistically different between the two groups suggesting that the higher prevalence of symptoms reported by the workers in the exposed group cannot be attributed to these allergens. On further analyses, we also did not find that women from the Low Cholinesterase Group were more likely to have abnormal allergy tests than women from the Normal Cholinesterase Group.

Table 10: Allergy tests (Serum-specific IgE levels)

Allergy test	**Exposed (n = 120)**	**Unexposed (n = 87)**
Phadiotop (ku/l, median, range)	0.16 (0.05-699)	0.36 (0.05-499)
HDM (ku/l, median, range)	0.03 (0-398)	0.03 (0-602)

Storage mite (ku/l, median, range) Spidermite (ku/l, median, range)	0.07 (0.03-34.4) 0.02 (0-17.9)	0.07 (0.04-34) 0.01 (0-6.4)
Sensitisation Phadiotop (n ,%) HDM (n ,%) Storage mite (n ,%) Spider mite (n ,%)	 46 (38.3) 29 (24.2) 23 (19.2) 18(15.0)	 44 (51.2) 26 (30.2) 21 (24.4) 17 (20.0)
* $P < 0.05$ comparing Exposed to Unexposed group		

5.3.4.4 Implications of symptoms, allergy and FE_{NO} testing results

These results demonstrated that more women exposed to pesticides on farms reported asthmatic respiratory and skin symptoms than those living in towns and that work-related symptoms are more common in this latter group especially when conducting outdoor work in the orchards. These results are consistent with previous studies in other setting that have shown high prevalences of these symptoms amongst farm workers (Hoppin et al, 2002, Innes et al, 1990, Dalvie et al, 1999, Zuskin et al, 1997, Senthilselvan et al, 1992, Mekonnen et al, 2002, Zhang et al, 2002, Hoppin etal, 2009). Although, the percentage of women with self-reported doctor diagnosed asthma and elevated levels of fractional exhaled nitric oxide was more in the group of women living in towns, the women with low cholinesterase levels (which is indicative of high pesticide exposure) were 5 times more likely to have elevated FE_{NO} levels (indicative of asthma) than those with normal cholinesterase levels. However, the percentage of women with allergy to mites was more in the group of women living in towns. Overall the results therefore indicate that the asthma symptoms reported by the women exposed to pesticides are not caused by allergens (indoor or outdoor) but probably due to the irritant effects of pesticides.. A recent study conducted on a large group of agricultural workers have shown evidence for non allergic asthma due to pesticides (Hoppin et al, 2009). Another explanation why the percentage of women with self-reported asthma in the Exposed Group was lower than that in the Unexposed Group could be due the fact that women that worked on farms in the past that had developed asthma, left the farm to work and live somewhere else. This effect is common with studies amongst workers that have this type of cross-sectional design and is called the Healthy Worker Effect (HWE).

5.4 Characteristics of farms and pesticide exposures on farms

5.4.1 Characteristics of farms that women from the Exposed Group live and/or work on

Table 11 lists the characteristics of farms that women in the Exposed Group live and/or work on to provide a description of the types of farms as well as to describe the working and living conditions on the farms. This section is included so that people who read this can compare these farms with other farms.

The farms on which women from the Exposed Group lived or worked on were predominantly export farms (71%). The export countries include England, Netherlands, other parts of Europe and Japan. Nearly half the farms were Tesco farms. On less than half (40%) of farms on which women from the Exposed Group lived or worked, the workers did not belong to a union.

The crops grown on the farms on which women from the Exposed Group and/or worked included apples, berries, pears, prunes, pink ladies, grapes, onions, peaches, naartjies, lemons, potatoes, guavas, oranges, lucern, plums, figs, mushrooms, olives and tomatoes. The crops grown were predominantly fruit with only one farm growing vegetables only.

The water source for drinking and recreational use in all the homes of the women in the Unexposed Group was municipal water whereas on the farms the water source included mostly storage dams, boreholes and municipal water but also unprotected sources such as a farm dam.

Women worked as pesticide applicators in nearly 20% of farms.

Although most women in the Exposed Group reported that free PPE are available on the farm, nearly a quarter of farm workers reported that PPE are not provided and more than two-thirds reported that there are no showers on the farm and about 75% of farm workers go back into the sprayed area on the same day when spraying occur.

Tractor with a boom was the most common spraying method reported being reported by virtually all the women in the Exposed Group.

Table 11: Characteristics of farms that women in the Exposed Group live and/or work on

Farm Characteristic	**Exposed Group (n = 121)**
Export farm:	
Yes	80(66%)
No	30(25%)
Don't know	2(2%)
Tesco farm:	
Yes	49(40%
No	61(50%)
Don't know	2(2%)
Farmer workers unionized	40(33%)
Source of drinking water:	
Municipal	21(17%)
Borehole	36(30%)
River	3(3%)
Farm dam	30(25%)
Storage dam on mountain	28(23%)
Rainwater tank	3(3%)
Water source for household use:	
Municipal	21(17%)
Borehole	36(30%)
River	3(3%)
Farm dam	30(25%)
Storage dam on mountain	28(23%)
Rainwater tank	3(3%)
Who on the farm apply pesticides:	
Women	0(0%)
Men	92(76%)
Both men and women	23(19)
Don't spray	1(1%)
Provision of PPE	
Yes	87(72%)
No	28(23%)
PPE free	
Yes	84(69%)
No	3(3%)
Farm showers available:	
Yes	45(37%)
No	69(57%)
Don't know	2(2%)

No longer a farm	3(3%)
Workers go into the work blocks shortly after it has been sprayed:	
Yes	88(73%)
No	26(21%)
No longer a farm	3(3%)
How soon after spraying occurs that the workers go back into the blocks:	
Same day	81(67%)
After 1 day	27(22%)
After 2-3 days	4(3%)
After 7 days	2(2%)
Method of applying pesticides:	
Tractor with boom-spray	113(93%)
Tractor without boom-spray	34(28%)
Backpack spray	45(37%)
Quad bike	24(20%)

5.4.2 Environmental and occupational exposure to pesticides

The following section describes the exposures to pesticide spraying at home and at work of the women in the Exposed Group.

Amongst those that currently live on a farm the average distance from nearest vineyard was 10 m and range 0-500 meters and the average last spray occurred 1 one day ago and range 0-33 days.

Of those that lived or worked on a farm the average number of spraying days in a year on the farm reported was 96 days and range 3-240 days.

Sixty-nine participants (32.7%) said that pesticides contaminate the house.

Fifty-two (53.6%) farm workers were seasonal farm workers. Eighty-seven (71.2 0%) of the women in the Exposed Group said that they come into contact with pesticides. Fifty-four (55.6%) farm workers work in the field (vineyards) while only 4 (4.1%) reported that they applied pesticides.

5.4.3 Implication of results on the characteristics of farms and exposures to pesticides

These results provides further evidence to that found in studies conducted previously amongst these communities (Dalvie et al, 2009 a, b &c; Dalvie and English, 2010; Dalvie et al, 2004; Dalvie et al, 2003; Dalvie and London, 2001) that farm residents are exposed to pesticides in the environment in number of ways. For instance the average distance of homes from the spraying area was 10 m, the average number of days of spraying reported was 96 days, about a third reported that pesticides comes into house, farm residents use unprotected water sources for drinking and recreation, the use of empty pesticide use for recreational use including drinking water was reported and the washing of pesticide contaminated clothing at home was also reported. Tractor with a boom, which produces a substantial amount of drift, was reported by virtually all the women in the Exposed Group. The percentage of farm workers (10%) that reported the use of empty containers for drinking purposes is higher than that found in previous studies amongst these communities (Dalvie et al, 2001; Dalvie et al, 2003; Dalvie et al, 2004, Holtman etal 2010, Dalvie and English 2010) and is an issue that needs to be particularly addressed. A recent study by our group has found that exposure to pesticides coming into the house was related to depression scores (Majors and London, 2008). Recent studies in the rural Western Cape have shown that the pesticides are present in the environment and that the levels measured amongst farm residents are high (Dalvie et al, 2009).

Regarding health and safety on farms, it is a major concern that that a high percentage of workers return to sprayed fields on the same day. Additionally nearly a quarter of farm workers reported that PPE are not provided, more than a third reported that there are no showers on the farm and nearly half reported that pesticide contaminated clothing is washed at home (Table 5). The provision of PPE and adequate washing facilities is a requirement in terms of the Hazardous Chemical Substances Regulations (Department of Labour, 1995). With less than half of farm workers unionized, unionization could address health and safety and other concerns of farm workers.

Although only 4 women in the study sample were applicators, it was reported that women worked as pesticide applicators in nearly 20% of farms. This is an issue for fair trade policy on gender .

5.5 Reproductive health services

This section deals with the access of the women to reproductive services.

Table 12 compares the number and percentage of persons in the Exposed Group and Unexposed Group that reported access to reproductive services. The two groups were compared statistically for each question and an "*" indicates when the two groups are statistically different.

Virtually all women living on farms and town reported that they had access to medical services for pregnancy and birth and more than three quarters to gynecological services predominant at state hospitals.

The access to services for sexually transmitted diseases was less than 40 % in all groups mostly at hospitals and clinics. The only other reproductive service reported was family planning.

Access to most reproductive health services especially to state hospitals was therefore reported by most (77-100%) participants. However, access to services for sexually transmitted diseases is a major concern as less than half of the participants reported access to these services. The study did not evaluate quality of reproductive health services.

Table 12: Access to reproductive services

Services	**Exposed Group (n = 121)**	**Unexposed Group (n = 87)**
Health services accessible for attending to:		
Pregnancy	119(98.3)	86 (95.6)
Birth of children	118(97.5)	84 (94.4)
Gynecologic care	100(82.6)	69 (76.7)
Sexually transmitted diseases	41(33.8)	27 (30.0)
* P –value < 0.05 comparing Unexposed to Exposed Group		

5.6 Limitations of the study

The study sample was not random and represented mostly export farms, but was recruited from 5 major agricultural areas in the Western Cape and from farms producing a variety of crops. The Unexposed Group was however, reduced due women currently living in towns but working on farms. There were also 25 women who are currently living in towns but had previously lived or worked on a farm. It was also not ideal that most women in the Unexposed Group (71%) were not working. It is likely that there may have been some element of exposure misclassification as a result.

The cross-sectional design of the study does not allow for investigating temporal relationships between exposure and outcome and can be influenced by the Healthy Worker Effect (HWE) whereby ill workers stop

working leaving a more "healthy" working population. HWE was prevalent in this study. Funding for measuring pesticides in blood and urine was not available and this data could therefore not analysed. The reproductive health instruments in this study was not feasible as the data collected could not be used.

6. Conclusions and Recommendations

The study found depressed cholinesterase levels amongst women working and living on farms in the Western Cape. This indicates that they are highly exposed to pesticides at their work and in their homes. The women living and working on farms thus absorb a lot of pesticides leading to a drop in their cholinesterase levels. These high pesticide exposures make them prone to health effects associated with these pesticides. Evidence of health effects due to pesticide exposure found in the study was the elevated levels of self-reported acute health effects, self-reported neurological symptoms and asthmatic and skin symptoms amongst the women working and living on the farms. Additionally, more women with low cholinesterase levels (indicating that they are highly exposed to pesticides) had elevated FE_{NO} levels indicating the presence of lung inflammation associated with asthma compared to women with normal cholinesterase levels. This suggests that the asthma symptoms reported by the workers are more likely to be related to the irritant rather than allergic effects of pesticides on the lung.

A number of health and safety issues as well as labour issues need to be addressed on farms to reduce pesticide exposures of women. The high pesticide exposures call for tighter regulation of pesticide spraying and also tighter regulation in the sale of pesticides. Toxic release and use inventories on farms should be documented regularly. Education of farmers, farm management and farm workers on the use of pesticides and their environmental and health effects is vitally important. There is also a need for the implementation of integrated pest management methods.

Although the women reported access to most reproductive health services especially to state hospitals, access to services for sexually transmitted diseases is a major concern. The quality of reproductive health services need to be studied in more detail.

Further study of the pesticide exposures amongst these women and the resulting health effects are required employing representative sampling, stronger designs and incorporating a wider range of age groups. The urinary samples collected during the study needs to be analysed in order to provide more detailed information about the current pesticide exposures experienced by the women. The effects of pesticides on asthma and the nervous system needs to explored further. Apart from neurological and asthmatic effects, reproductive health effects needs to be investigated in more detail as the time to pregnancy data collected in the study was not usable.

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Pathcare

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9. Appendices

APPENDIX 1: QUESTIONNAIRE

Health effects due to pesticide exposure amongst rural women in the Western Cape

UNIVERSITY OF CAPE TOWN

Study Number _____

Date _____

Area _____

Farm Name _____

Name of Interviewer _____

GENERAL INSTRUCTIONS

Thank you for agreeing to take part in this study.

We will work through the questionnaire as follows: I will ask the questions and give you the answer choices and tick or circle the answers you give me in the questionnaire. Choose the answer that is the closest to how you feel.

Please note that there are no right or wrong answers to the questions asked. Please feel free to answer just what you think. You may stop at any time if you do not want to carry on with these questions. Your answers are confidential and will not be shared with anyone. Only the research staff will have access to the questionnaire once it has been completed.

Section 1: DEMOGRAPHIC CHARACTERISTICS

We would like to ask you a few questions about yourself.

1.1 How old are you? _____ (years)

Date of birth ____/_____/_____

1.2 What is the highest level of education you have passed?

Less than one year completed	1
Sub A/Class 1/Grade 1	2
Sub B/Class 2/Grade 2	3
Standard 1/Grade 3	4
Standard 2/Grade 4	5
Standard 3/Grade 5	6
Standard 4/Grade 6	7
Standard 5/Grade 7	8
Standard 6/Grade 8	9
Standard 7/Grade 9	10
Standard 8/Grade 10	11
Standard 9/Grade 11	12
Standard 10/Grade 12	13
Further studies – incomplete	14
Diploma/other post school – complete	15
Degree	16

1.3 Which main language do you speak at home? _____

Section 2: HOUSEHOLD FACTORS

2.1 Is the house you live in:

Owned by your family	1
Rented	2
Owned by the owner of the farm	3
Other (please specify)	4

Specify _____

2.2 Does your house have:

		Yes	No

A	Electricity		
B	A radio		
C	A television		
D	A landline telephone		
E	A fridge		
F	A computer		
G	A washing machine		
H	A cell phone (anybody)		

2.3 How many people usually live and sleep in your household?

	Number of people

Section 3: ECONOMIC FACTORS

Now we would like to ask a few questions about you and the work that you do.

3.1 What kind of work do you do? (If working, please tell me your occupation. For example, Farmer, Street Trader, Primary School Teacher, Domestic Worker)

Not working	No
Working	Yes
If working, specify	

3.2 Please indicate which of the following are your sources of income. Please answer this question whether or not you are working.

		Yes	No
A	Work		
B	Spouse/partner		
C	Parents		
D	Brothers and/or sisters		
E	Children		
F	Child Support Grant		
G	State Old Age Pensions		
H	Disability Grant		
I	Care Dependency Grant		
J	Foster Care Grant		
K	Grants-in-Aid		
L	Workman's Compensation Fund		

M	Other (Please specify)		

3.3 What is your household income? _____

3.4 How often do the people in your family go hungry or have no food to eat?

Never	0
Seldom	1
Sometimes	2
Often	3

3.5 During which months of the year do you go hungry? _____ (months of year).

Section 4. RESIDENTIAL HISTORY

Now I'd like to ask you a few questions about the places where you have lived in your lifetime:

4.1 Where do you currently live (Town, city, farm)? _____

How long have you lived here? _____ (Years/Months)

If on a farm,

4.2 What kind of farm is this? (what is grown here?) _____

4.2.1 Is this an export farm? _____ (Yes, No)
If yes, where are crops exported to? _____ (countries)

4.2.2 Is this a Tesco farm _____ (Yes, No)

4.3 How far from your house is the nearest vineyard/orchard? _____ (meters)

4.4 Are pesticides sprayed on the vineyard/orchard during the year? ____ (Yes/No)

4.5 When last was pesticides applied in the vineyard/orchard? _____ (number of days)

IF YES, complete the following:

4.5 How many months a year are pesticides applied on the farm _____

How many days per month are pesticides applied during the spraying months? _____

Number of days per year _____

4.6 Does the pesticides spraying come into the house? _____ (Yes/No)

4.7 Do you come into contact with pesticides outside the house while spraying occurs (e.g. hanging your washing? . _____ (Yes/No)

4.8 Who apply pesticides on this farm _____(Men, Women, Both)

4.9 Does the farmer provide you with protective clothes and equipment (including gloves, masks, overalls, etc? _____

If yes, is it free of charge? _____ (Yes, No)

4.10 Are shower/washing rooms provided for workers coming into contact with pesticides?

_____ (Yes, No)

4.11 When spraying happens, are workers expected to work in sprayed blocks? ___(Yes, No)

4.12 How soon after spraying/application of pesticides do you return to the vineyard/orchard? _____ (number of days)

4.13 What is the method of pesticide application? _____ (Tractor, backpack or other methods)

4.14 What are the sources of drinking water at your house? _____ (municipal water, storage dam on mountain, borehole/spring, river water, farm dam, rain water tank, etc)

4.15 What are the sources of water for recreational use (bathing, washing of clothes) at your house? _____ (municipal water, storage dam on mountain, borehole/spring, river water, farm dam, rain water tank, etc)

4.16 Did you live elsewhere before? _____ (Yes/No)

If YES,

Please provide the details about the places where you have lived **PREVIOUSLY** in the following table:

	Places lived previously										
	1	2	3	4	5	6	7	8	9	10	11
Number of years											
Was pesticides sprayed on the farm?											

4.12 Were you born on a farm where pesticides were applied? ___ (Yes/No)

Section 5. WORK HISTORY

Current job

5.1 What is your current occupation? _____

5.2 What is your job title? _____

5.3 For how many years have you worked in this job? _____ (years)

5.4 Do you currently work on a farm? ___ (Yes/No)

If you work on a farm,

5.5 Are you a permanent or seasonal farm worker? _____

5.6 If you do not live on the farm you work at:

5.6.1 Which crops are produced on the farm _____
5.6.2 Is the farm you work on an export farm? _____ (Yes, No)
If yes, where are crops exported to? _____ (countries)

5.6.3 Is the farm you work on a Tesco farm? _____ (Yes, No)

5.7.1 Do you work in the field? _____ (Yes/No)

5.7.2 Do you apply (spray/mix) pesticides _____ (Yes/No)

5.7.3 If YES which pesticides do you use _____

_____

5.7.4 When last did you apply pesticides? _____ (number of days)

5.7.5 How many months a year do you apply pesticides? _____

How many days per month do you apply pesticides in the spraying months? _____

Total number of days per year _____

5.7.6 Do you drive a tractor while others spray pesticide? _____(Yes/No)
If yes, how many times per year? _____

5.7.7 Which Personal Protective Equipment do you use? _____
(Indicate with A = Apron, B = Boots, G = Gloves, M = Mask, O = Overalls, Gls = Goggles)

5.78 Is PPE provided free of charge? _____ (Yes, No)

Previous jobs

Please provide the details about your **PREVIOUS** work in the following table

	Previous jobs										
	1	2	3	4	5	6	7	8	9	10	11
Number of years											
Work on a farm (Yes, no)											
Occupation											
Job Title											
If on farm:											

Do you work in the field? (Yes, No)											
Do/did you apply (spray or mix) pesticides (Yes, No)											
How many days per year do/did you apply pesticides?											
Were you the tractor driver ? (Yes, No)											
How many days per year were you the tractor driver?											
Which PPE did you use?*											
*Indicate with A = Apron, B = Boots, G = Gloves, M = Mask, O = Overalls, Gls = Goggles											

Section 6. ALCOHOL USE

6.1 Do you drink alcohol or did you drink before _____? (Yes/No)

If yes,

6.2 Have you ever felt that you should drink less alcohol? ____ (Yes/No)

6.3 Have people ever angered you by criticising your drinking habits? ____ (Yes/No)

6.4 Have you ever felt guilty or bad because you drink alcohol? ____ (Yes/No)

6.5 Have you ever had a drink early in the morning to make you feel better or to get over a 'babalaas'? ____ (Yes/No)

Section 7. SMOKING AND OTHER DRUG USE

7.1 Have you ever smoked tobacco (cigarettes or pipe) for as long as a year? ____ (Yes/No)

('Yes' means at least 20 packs of cigarettes or 30 grams of tobacco in a lifetime or at least one cigarette per day for one year)

If Yes,

7.1.1 How old were you when you started smoking? ____ (years)

7.1.2 Do you smoke currently? ___ (Yes/No)
('Yes' means smoking tobacco in the last month or more)

7.1.3 If no, how old were you when you stopped smoking? _____

7.1.4 How much do/did you now smoke on average?

Number of cigarettes per day ____

Pipe tobacco in grams/week _____

7.1.5 Do you or did you inhale the smoke? ____ (Yes/No)

7.2 Have you been regularly exposed to tobacco smoke from other people smoking cigarettes or pipe in the last 12 months?
('Regularly' means on most days or nights)

7.3 Do you take drugs or have taken drugs before? _____ (Yes/No)

7.3.1 If YES, please state for how many years _____ (years)

Section 8. HOUSEHOLD PESTICIDE USAGE

8.1 Do you or any one in your house use pesticides in the garden or in your home?____ (Yes/ No)

If yes, what do you use? _____

8.2 Do pesticide contaminated clothes get washed at home? ____ (Yes/ No)

8.4 If yes, does it get washed with the rest of the washing? _____ (Yes/ No)

8.5 Do you eat fruit or vegetables from your garden ? _____ (Yes / No)

8.6 Do you use empty pesticide containers at home for domestic purposes? ____(Yes/ No)

8.7 **If yes,** what do you use them for? _____

Section 9 MEDICAL, REPRODUCTIVE AND RESPIRATORY HISTORY

9.1 Do you suffer from :
Asthma _____ (Yes/No)
Bronchitus _____ (Yes/No)
TB _____ (Yes/No)
Eczema _____ (Yes/No)
Hayfever _____ (Yes/No)
Farmers Lung _____ (Yes/No)
Other diseases: _____ (Yes/No) **if yes,** specify _____

9.2 What was your weight at birth _____
9.3 At what age did you reach puberty? _____
9.4 Did you ever experience pesticide poisoning that was confirmed by a doctor? ____(Yes, No)

If yes, how many times_____

9.5 Do you frequently feel/have :
Dizzy _____ (Yes/No)
Nauseas _____ (Yes/No)
Headaches _____ (Yes/No)
Skin, nose and/or eye irritation _____ (Yes/No)
Skin rashes _____ (Yes, No)
Nauseas and want to vomit (Yes, No)
Cold or open sores _____ (Yes, No)

Section 10 (Q16)

10.1. Are you abnormally tired? ____ (Yes / No)

10. 2. Do you have palpitations of the heart when you do not exert yourself? ____ (Yes/No)

10. 3. Do you often have painful tingling in some part of your body? ____ (Yes/No)
10. 4. Do you often feel irritated without any particular reason? ____ (Yes/No)
10. 5. Do you often feel depressed without any particular reason? ____ (Yes/No)
10.6. Do you often have problems concentrating? ____ (Yes/No)

10. 7. Do you have a short memory? ____ (Yes/No)

10. 8. Do you often perspire without any particular reason? ____ (Yes/No)
10. 9. Do you have any problems with buttoning and unbuttoning? ____ (Yes/No)
10.10 Do you generally find it hard to get the meaning from reading newspapers and books? ____ (Yes/No)

10. 11.Have your relatives told you that you have a short memory? ____ (Yes/No)

10. 12. Do you sometimes feel a heavy feeling on your chest? ____ (Yes/No)
10. 13. Do you often have to make notes about what you must remember? ____ (Yes/No)

10. 14. Do you often have to go back and check things you have done such as locking the door? ____ (Yes/No)

10. 15. Do you have a headache at least once a week? ____ (Yes/No)

10. 16. How many times do you have sex per week? ____ (Yes/No)

10. 16a. Do you think that this is less than most persons of your age? ____ (Yes, No)

Section 11. Time to pregnancy

11. 1. Have you ever been pregnant? _____ (Yes/No)

11. 2. If yes, how many times? _____

11. 3. List how many pregnancies ended in

Live birth ____
Stillbirth ____
Miscarriage ____
Ectopic/Tubal pregnancy ____
Other ____

11.4 FOR LIVE BIRTHS AND STILLBIRTHS ONLY (omit twins) Fill in the following Table:

	Pregnancy										
	1	2	3	4	5	6	7	8	9	10	11
Weight of baby (kg)											
During the month this pregnancy was conceived, were you or your husband using any form of birth control? (Yes, No)											
Method of birth control*											
Were you using birth control all the time, nearly all the time, or only sometimes?											
If NO BIRTH CONTROL or ONLY SOMETIMES: How many months did it take you to get pregnant?											
*oral (the pill), intrauterine device (coil, loop), condoms, diaphragm (cap), rhythm or withdrawal, other											

Section 12. ALLERGIC HEALTH PROBLEMS

12.1 Have you had wheezing or whistling in your chest at any time in the last 12 months? _____ (Yes/No)

If yes, go on to Question 12.2
If no, go on to Question 12.4

12.2 Have you been short of breath when the wheezing noise was present? _____ (Yes/No)

12.3 Have you had this wheezing or whistling when you did not have a cold or flu? ___ (Yes/No)

12.4 Have you been woken up with a feeling of tightness in your chest at any time in the last 12 months? _____ (Yes/No)

12.5 Have you had an attack of shortness of breath that came on during the daytime when you were at rest at any time in the last 12 months? ____ (Yes/No)

12.6 Have you been woken by an attack of coughing at any time in the last 12

months? _____ (Yes/No)

12.7 Have you ever had asthma? ____ (Yes/No)

If Yes, go on to Question 12.
If No, skip to next Question

12.8 If yes, was this confirmed by a doctor?

12.9 How old were you when you were told you have asthma? _____ (years)

12.10 Have you had an attack of asthma in the last 12 months? _____ (Yes/No)

12.11 Are you using any medicines, including inhalers/pumps, nebulizers, syrups or tablets, for asthma or breathing problems? ____ (Yes/No)

12.12 When you are near animals, feather or in a dusty part of the house, do you ever get a feeling of tightness in your chest? ____ (Yes/No)

12.13 Do you get a tight chest or wheeze when you work in the:
12.13.1 Vineyard/Orchard ____ (Yes/No)
12.13.2 Packing room ____ (Yes/No)
12.13.3 Other ____ (Yes/No) If yes, specify _____

12.14 Have you had any nasal allergies including hay fever or itchy and watery eyes/nose in the last 12 months? ____ (Yes/No)

12.15 Do you get itchy/watery eyes or nose when you work in the:
12.14.1 Vineyard/Orchard ____ (Yes/No)
12.14.2 Packing room ____ (Yes/No)
12.14.3 Other ____ (Yes/No) If yes, specify _____

12.16 Have you had any skin problems in the last 12 months? ____ (Yes/No)

12.17 Do you get red, itchy pimples when you work in the:
12.17.1 Vineyard/Orchard ____ (Yes/No)
12.17.2 Packing room ____ (Yes/No)
12.17.3 Other ____ (Yes/No) If yes, specify _____

Thank you for taking part in this study

APPENDIX 2: EXHALED NITRIC OXIDE PRE-TEST DATA COLLECTION SHEET

UCT OCCUPATIONAL ALLERGY AND ASTHMA STUDY AMONG VINEYARD WORKERS IN THE WESTERN CAPE PROVINCE OF SOUTH AFRICA - 2009

EXHALED NITRIC OXIDE PRE-TEST DATA COLLECTION SHEET

Survey Number _____

A. IDENTIFICATION DATA

1.Surname _____

2. First name/s _____

3. Work number _____

4. Date of birth: Day_____Month_____Year____

5. Gender: Male (1)
Female (2)

8. Interviewer's initials _____

9. Date of interview:

Day____Month_____Year_____

10. Farm: _____

B.HEALTH PROBLEMS

Recent chest infections

1. Have you had the flu or sinusitis in the past 3 weeks?

Yes (1)
No (2)

2. Are you being treated for Tuberculosis (TB)?

Yes (1)
No (2)

2.1 If yes, for how long? _____months _____weeks

If YES, to next question, indicate to person that the tests will not be done today. Schedule another appointment in three months time since the start of TB medication.

Nose and eye symptoms

4. Have you ever had any nose or eye problems due to allergies and/or hay fever?

Yes (1)
No (2)

C. SMOKING HISTORY

1. Do you smoke?

Yes (1)
No (2)

1.1 If yes, have you smoked (cigarettes/tobacco) in the last hour?

Yes (1)
No (2)

D. ALCOHOL CONSUMPTION

1. Do you drink alcohol?

Yes (1)
No (2)

1.1 If yes, when have you last consumed alcohol?

1-2 hours ago (1)
1 day ago (2)

1 week ago (3)

1.2 How much alcohol did you consume?

_____

E. MEDICATION USAGE (show booklet)

1. Are you taking any medicine/s from a doctor or clinic at the moment for asthma, and or hayfever?

Yes (1)
No (2)

1.1 If yes, what are you taking and when last did you take them?

Names		No. of hours since last dose
_____		_____
_____	_____	_____
_____	_____	_____

F. PHYSICAL ACTIVITY

1. Do you exercise?

Yes (1)
No (2)

2. When was the last time you exercised?

1-2 hours ago (1)
1 day ago (2)
1 week ago (3)

G. RECENT FOOD INTAKE

1. Did you have anything to eat or drink in the last hour?

Yes (1)
No (2)

If YES to above question, reschedule test for at least 1 hour later the same day or another date.

APPENDIX 3: EXHALED NITRIC OXIDE DATA COLLECTION SHEET

UCT OCCUPATIONAL ALLERGY AND ASTHMA STUDY AMONG WOMEN ON FARMS PROJECT IN THE WESTERN CAPE PROVINCE OF SOUTH AFRICA - 2006 2009

EXHALED NITRIC OXIDE DATA COLLECTION SHEET

Date: _____

Time _____

Ambient NO concentration (ppb) _____

Ambient temperature (degrees celcius) _____

Survey Number _____

1. Subject's blood pressure systolic _____

diastolic _____

2. Subject's age (in years) _____

3.1 Subject's height (in centimetres) _____

3.2 Subject's weight (in kilograms) _____

4. Gender: Male (1)

Female (2)

5. Effort number (start) _____

6.1 FENo measurement (ppb) 1st effort _____

6.2 FENo measurement (ppb) 2nd effort _____

6.3 FENo measurement (ppb) 3rd effort _____

APPENDIX 4: CONSENT FORM

Consent to participate in a survey investigating health effects due to pesticide exposures on women from the rural Western Cape

1. Title of research project

Health effects due to pesticide exposure amongst rural women residents in the Western Cape

2. Names of the researchers

Mohamed Aqiel Dalvie (BSc, Honours, MSc, PhD)
Mohamed Jeebhay (MbChB, MMED, PhD)
Leslie London (MbChB, MMED, PhD)

3. Purpose of research

This study is being conducted by The University of Cape Town to investigate the health effects of pesticides on women in the Western Cape. We would like to conduct measurements on you. The study will be of benefit to women living in farming areas and who are exposed to pesticides in the environment.

4. Description of the research project

You will be required to produce a urine and 2 blood samples and undergo a respiratory test and you will complete a questionnaire.

a) **Questionnaire:** A member of our study team will interview you in privacy to complete the questionnaire. You will be asked questions about general personal information, your general medical health, and lifetime environmental exposure to pesticides.
b) **Urine sample:** Your will produce a urine sample (in privacy) in a plastic container and give it to the nurse. The sample will be analysed for pesticides.

c) **Blood sample:** A nurse will draw 9 ml blood from a vein on your arm. The blood will be analysed for to test your allergy status.

d) **Respiratory test:** A nurse will perform a respiratory test.

5. Risks and discomforts of the research

a) **From the blood tests**. A single needle stick will be felt when the blood is taken. Sometimes a small bruise may occur from the needle stick, but this is minor and will heal quickly. The total amount of blood taken is quite small and the body will quickly replace it. Blood samples will be used only to measure allergy and will be destroyed at the end of the study.

b) **From the questionnaire.**
There are minimal risks associated with completing the questionnaire. The only risk is a loss of confidentiality about personal information but the data will be seen only by study personnel. All reports will present aggregate data in which individuals will not be identifiable.

6. Expected benefits to you and others

Your health will be assessed for free and you will be referred to a public health facility should we identify any health problems.

Refreshments will be provided as compensation for time in participating in the study.

This study on the health effects of pesticides will benefit women living in farming areas and who are exposed to pesticides in the environment. Steps can be taken to reduce or prevent exposure to the pesticides or the pesticide can be banned. The blood and urine results can be used to develop ways in which the amount of pesticides in your body can be monitored.

7. Costs to you resulting form participation in the study

The study is offered at no cost to you.

8. Confidentiality of information collected

Study participants will not be personally identified in any reports on this study. The records will be kept confidential to the extent provided by law. The records, including any identification information, will be destroyed after the results have been fully analysed.

9. Documentation of the consent

One copy of this document will be kept together with our research records on this study. A second copy will be given to you to keep.

10. Contact person.

You may contact the following person for answers to further questions about the research, your rights, or any injury you may feel is related to the study.

Name of person: MA Dalvie (The principal investigator) telephone 021 4066610
Name of person: Lamees Emjedi (Ethics administrator) telephone 021 4066492

11.Voluntary nature of participation

Your participation in this project is voluntary. Subsequent to your consent, you may refuse to participate in or withdraw from the study at any time without penalty or loss of benefits to which you may otherwise be entitled.

12. Consent of the participant

I have read the information given above. I understand the meaning of this information. I hereby consent to participate in the study.

_____ _____

Printed name of participant ***signature***

_____ _____

Date

_____	_____	_____
Interviewers (print)	**signature**	**Date**
_____	_____	_____
Witness (print)	**signature**	**Date**

***Date:*_____**

Study Number _____