Journal of Rural and Community Development

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Citation:
de Verteuil, P., Isaac, A. P., Legall, G. (2016). Risk factors for chronic and acute pesticide poisoning among waged and licensed farm workers in rural Trinidad and Tobago. *Journal of Rural and Community Development*, *11*(2), 89-109.

Publisher: Rural Development Institute, Brandon University.

Editor: Dr. Doug Ramsey

ISSN: 1712-8277 © Journal of Rural and Community Development
www.jrcd.ca

Risk Factors for Chronic and Acute Pesticide Poisoning among Waged and Licensed Farm Workers in Rural Trinidad and Tobago

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Abstract

Agricultural pesticide applicator's work ranks high amongst the most hazardous occupations as it relates to workplace illnesses. Yet, little is done to protect this vulnerable occupational group who are routinely exposed to highly toxic pesticides in the fields where they work in Trinidad. This study seeks to identify and assess the behaviours and common practices of waged pesticide applicator farm workers, which put them or their family members at risk of becoming acutely or chronically poisoned. In this paper, both descriptive and inferential analyses were performed on the results from 97 verbally administered questionnaires. The results showed the various risky practices that farm workers are regularly engaged in that increases their likelihood of suffering from illnesses that are related to acute and chronic pesticide poisoning and highlights the need for more emphasis on training in occupational health and safety in pesticide use in Trinidad and Tobago.

Keywords: risk factors; pesticide poisoning; farm workers

1.0 Introduction

Agricultural pesticide applicators work ranks high amongst the most hazardous occupations as it relates to workplace illnesses (Cabrera & Leckie, 2009). Yet little is done to protect this vulnerable occupational group who are routinely exposed to the highly toxic pesticides in the fields where they work. Approximately 5.1 billion pounds of pesticides are applied to agricultural fields per year. This has led to the adverse acute effects experienced by thousands of farm workers (Alexe, Petridou, Themis, & Trichopoulos, 2004).

Studies have indicated that due to the disproportionately high use of pesticide, agricultural workers are at greater risk of pesticide exposure than any other group (Calvert et al., 2008). Agricultural workers may make direct contact with pesticides during preparation and application activities.

Additionally, there is also the unintentional exposure to pesticides when farm workers are not directly handling the chemicals preparations, but are present in the treated area at the time of its application. Unintentional exposures may also arise due to exposure to off-target pesticide drift a hasty re-entry into pesticide-treated areas while performing non-pesticide related farming activities such as pruning.

Exposure to pesticides may lead to the poisoning of individuals. This may either be expressed acutely, or chronically, depending on the length of time an individual is exposed. Several bans and restrictions have been imposed on certain pesticides due to the negative environmental and health impacts that usually accompany their use in developed countries (Maumbe & Swinton, 2003). Unfortunately, several of these pesticides that have been banned, highly restricted and or even withdrawn from the developed nations, now have a strong market presence in several developing countries. These pesticides are now heavily marketed, produced and even sold there illegally in many cases (Baksh, Ganpat, & Narine, 2015; Mansour, 2004).

It is important to note that pesticide poisoning is commonly considered an under-diagnosed illness that often debilitates individuals who are exposed to these harmful chemicals. Cases of acute pesticide poisoning often account for significant morbidity and mortality worldwide with particular reference to developing countries (Thundiyil, Besbelli, & Pronczuk, 2008). It has been reported that chronic exposures to pesticides may lead to elevated risks of certain types of cancer, neurotoxicity, teratogenicity, immunotoxicity and developmental effects in the unborn (Mansour, 2004).

As the seasons change, there are noticeable variations in the demand for farm workers and the nature of their jobs. Arduous tasks in addition to extremely long working hours are habitually endured during planting and harvesting season. Due to the intensity of the work, there is often little opportunity for intermission; consequently workers are at risk of extended exposure. Waged farm workers of agricultural households, are a particularly vulnerable group, as they are generally seen to have more risky agricultural practices than those of farm holders.

Studies have shown that those who often resort to employment as agricultural labourers are generally those who are of the opinion that their options are restricted as they are incapable of securing employment elsewhere (Cabrera & Leckie, 2009). Consequently, farm workers hold a resigned acceptance that adverse health effects are associated with their jobs. Due to wage insecurities and high dependency on the employing farmer as sole provider of cash income, these labourers work arduously and generally accept high risk tasks (van Dijk, 2012).

Additionally, workers with these precarious jobs often receive less training and supervision as safety is not carefully controlled. It therefore contributes to high occurrences of work-related injuries and diseases (Santana & Loomis, 2004). As a result, these workers are less likely to have an awareness of workplace hazards or report injuries inflicted upon them. One study revealed that 75.9% of a sampled agricultural field workers' population had experienced pesticide related illnesses (Das, Steege, Baron, Beckman, & Harrison, 2001). It was also noted that due to the lack of knowledge about the pesticides workers dealt with and have been exposed to, there tends to be an underestimation of the number of pesticide-related illness incidence (Baksh, Ganpat, & Narine, 2015).

In most developing countries mechanized aids are rarely used since work is heavily dependent on physical strength. Often, there seem to be a lack of work standards among farm workers and physical limits are self-imposed (Calvert et al., 2008). Additionally, most farm workers tend to have limited access to technological advice and health services. A survey conducted in regions where the use of pesticides is moderate to very intensive and the practices of users were considered to be less well-developed had a startling revelation. It was largely targeted at smallholders who sprayed pesticides on smaller than average holdings, as such users are believed to be amongst the least likely to receive training in the use of agrochemicals. Studies revealed knapsacks and hand held fixed line sprayers were at a considerably higher risk of off-target drift exposure to pesticides than those using mechanized vehicle (tractor) sprayers (Tomenson & Matthews, 2009).

The move towards increased crop production has led to increased mechanization as well as the increased use of pesticides. However, even though technological advancement has facilitated the reduction of laborious manual tasks, it has introduced new risks of health and safety problems. Several problems are associated with the use of sophisticated machinery and the increased application of chemicals in the absence of appropriate safety measures, information and training (Maumbe & Swinton, 2003). Consequently, the injuries received are among the most severe ones and are responsible for a large number of fatalities and lifetime disabilities.

Mechanization coupled with the use of chemical products and biological preparations have brought about essential changes for agricultural workers. This is especially obvious in developed countries. Globally, the use of pesticides has contributed to dramatic crop outputs and has significantly decreased spread of certain diseases (Mansour, 2004). Due to the benefits derived from the usage of pesticide, it has been generally regarded as the three-legged support of efficiency (Newman, 1978). These benefits include: (a) significant increase in production, (b) the overall increased quality of production and (c) the reduction in agricultural labour and energy expenses form the fundamental basis of Newman's theory.

Data regarding both the use and sales of pesticides globally often prove to be difficult. More so, accuracy of the data gathered poses another challenge and may be viewed as being unreliable (Jayasinghe & Pathirana, 2012). Nonetheless, surveys conducted by the Food and Agriculture Organization (FAO) revealed that countries of Western Europe, The United States and Japan accounted for 62 % of the world's pesticide market sales of USD$30 billion (Mansour, 2004). However, the growth of this market has stagnated among the developed world due to bans and restrictions imposed. The move was highly attributed to the negative environmental and health impacts that accompany the use of such pesticides (Maumbe & Swinton, 2003).

Conversely, though a substantial amount of sales of pesticide are done by the developed world; the greatest increase in the pesticide sales market is by the developing world. Several of the highly restricted, banned and even withdrawn pesticides previously marketed and sold in the developed countries are now marketed and produced in several developing countries (Maumbe & Swinton, 2003). The former and highly toxic Organophosphorus (OP) and Carbamates presently have a strong market presence as sales of these pesticides are substantial.

Regionally, the most intensive consumers of pesticide throughout the Latin American countries and the Caribbean are Costa Rica and Belize (18.0 and 17.4 metric tons/hectare (MT/ha) respectively), followed by Trinidad and Tobago (13.3 MT/ha) (Maumbe & Swinton, 2003). Surveys conducted in 1993 indicated that the twin islands of Trinidad and Tobago have had a consumption rate of 16 metric tons per hectare (MT/ha) of growth regulators (Knoema Resource Statistics, 2013).

Studies have indicated that due to the disproportionately high use of pesticides, farmers and farm workers are at a greater risk of pesticide exposure than any other group (Calvert et al., 2008). Exposures to pesticides can occur by means of ingestion, inhalation, dermal absorption or ocular contact (Repetto & Baliga, 1996). The direct handling of pesticides during farming activities such as, preparation and application can result in farm workers making contact with these chemical substances. Furthermore, there is also the unintentional exposure to pesticides while performing non-pesticide related farming activities such as pruning and harvesting.

El Batawi (2003) identified four large groups who are potentially exposed to pesticide hazards:

- Farmers and Farm workers;
- Workers and Laborers in pesticide factories;
- Population that live in areas of intense pesticide use;
- Population exposed to persistent pesticides that bioaccumulate in food

Family members of this group, particularly children, are also at high risk of exposure to pesticides. In many developing countries, families tend to share the workload. Women and children can often be seen assisting with both the preparation and application of pesticides in many countries in developing countries. Within the Benguet District, Philippines, approximately one-third of the farm workers' children assist with the application of pesticide, and one-half of the farm workers' wives aid with farming activities (Mansour, 2004).

Even if children are not directly exposed to the pesticides in the agricultural fields, they may still become exposed as their parents introduce residual chemicals into the home by means of their protective clothing. The risk of becoming poisoned is then further exacerbated by children's inherently vulnerable biological makeup. Due to a child's remarkably high metabolic rate coupled with factors such as the high permeability of their skin and a high skin to weight ratio, this makes them predisposed to the adverse effects of pesticide exposure (Cabrera & Leckie, 2009).

Quite often, the deficiencies observed in pesticide handling and the effectiveness of personal protective equipment are said to be the leading cause of hazardous exposures (Jayasinghe & Pathirana, 2012). The public health risks of pesticides are dependent on a plethora of factors. Consequently, determining the severity and likelihood of effects from acute or chronic pesticide exposure proves difficult. The manifestation of these effects are dependent on a myriad of factors such as the specific agents involved, dosage, the existence of co-morbidities (health profile), routes of exposure, risk-related demographic, and other socio-economic factors (Loevinsohn, 1987).

Additionally, where there is a gap between regulation and enforcement of the policies that govern the purchasing, labelling and storage of these chemicals, the likelihood of exposure greatly increases. Other factors such as illiteracy, lack of training, inadequate access to information systems, poorly maintained or non-existent personal protective equipment and shortages of washing facilities after use further exacerbates the problem Baksh, Ganpat, & Narine, 2015). This was quite evident within the district of Chipinge, Zimbabwe, as farm workers who were challenged by the inability to read pesticide labels, were more likely to spray without the adequate use of protective clothing (El Batawi, 2003). Likewise, the use of highly toxic pesticides, obsolete stockpiles and improper storage techniques may provide unique risks.

It is important to note that pesticide poisoning is a commonly under-diagnosed illness that often debilitates individuals exposed to these harmful chemicals. Cases of acute pesticide poisoning often account for significant morbidity and mortality worldwide with particular reference to developing countries (Thundiyil, Besbelli, & Pronczuk, 2008). Unfortunately, most of the severe poisoning cases never reach the hospital and many of those that do are misdiagnosed as a stroke or respiratory and cardiovascular diseases (Analchem Resources, 2000).

Few studies have documented the risk factors for chronic and acute occupational pesticide poisoning among pesticide applicators. However, where they do exist very few are focused on specific chemicals. Often there are challenges in quantifying the magnitude of pesticide poisoning, which has been highly attributed to the limitations of a country's farm injury data sources. Comparisons of mortality and incidence as it relates to pesticide poisoning have proven to be more difficult as reporting systems vary from country to country with the absence of data sources proving to be the most difficult.

Despite the enormity and the severity of farm injuries and illnesses worldwide, the issues have received inadequate attention. Often, there is a paucity of data regarding farm pesticide poisoning, illnesses incidence and their underlying risk factors (Alexe et al., 2004). In developing countries such as Trinidad and Tobago, data on agricultural accidents are usually unavailable. With restricted access to information, the pesticide-related poisoning dilemma is then further amplified. Even though there have been reported cases of pesticide poisoning locally, there is a lack of in-depth analysis as the data provided are often inadequate and inconsistent. This makes it difficult to develop specific public health initiatives with the intention of improving preventative measures against pesticide related illnesses.

Undeniably, agricultural pesticide application work is viewed as one of the most hazardous occupations as it often results in high morbidity rate. Yet, agricultural workers are seen to be among the least well-protected as they have limited access to health care, workers' compensation, long-term disability insurance and survivors' benefits (Tomenson & Matthews, 2007). Due to the limited amount of training received in Occupational and Environmental Health, especially in pesticide related illnesses, clinicians and health care providers are inadequately equipped to contend with matters of this magnitude (Das, Steege, Baron, Beckman, & Harrison, 2001).

It is therefore of paramount importance that the injury-reporting systems in farm work become standardized both at an international and national level. This would ensure the adequate coverage of the total agricultural working population (Repetto & Baliga, 1996). Therefore, national health strategies should place greater emphasis on illness prevention rather than a curative and rehabilitative aspect.

Much investment is needed in the area of farm illnesses prevention. Due to the newly attained knowledge of the enormity and severity of this hazardous industry, farm workers' illness can be significantly minimized as their protection is brought to the forefront of policy makers' minds. This serves as important tool for lobbying for the protection of this vulnerable group. The current project's goal was designed to help bring to light the need for proper education on issues of pesticide related illnesses and training of farmers in areas of pesticide storage, application and handling, as well as proper hygienic practices with hopes of improving future extension training programmes.

In Trinidad and Tobago, the Pesticide Control Board has registered over 700 pesticide formulations for importation and sale in the country. Most of the popularly used pesticides have been recorded to contain the same active chemicals, namely Paraquat. Brands such as Gramoxone, Swiper, Fastac, Lannate, and Diazinon are recorded to be the most commonly used and purchased brands (Wesseling, Hogstedt, Fernandez & Ahlbom, 2001). Unfortunately, brands such as Diazinon, Diuron, Gramoxone, Herbiquat, Chemquat, Malathion and Fosferno are of great toxicological concern as they possess high acute and chronic toxicity.

Health and safety issues, particularly in developing countries, are exacerbated by the lack of general hazard awareness, the improper use and or absence of personal protective equipment, difficulty of using protective clothing in tropical climates, shortage of facilities for washing after use, illiteracy, labelling difficulties related to either language, complexity or misleading information, lack of regulatory authorities and finally, the lack of enforcement. Due to the absence of a standardized case definition of pesticide-related health effects, there are currently no reliable estimates.

Very little is done to safeguard the welfare of pesticide applicator farm workers who are routinely exposed to highly toxic pesticides at their workplaces. These workers are at a far greater risk than any other occupational group of becoming acutely or chronically poisoned. This problem is then further exacerbated as farm workers tend to work irregular hours, with no limit to the daily or weekly work regimen and have little to no control over factors that lead to their frequent exposures. Consequently, this occupational group requires immediate attention.

Due to the lack of enforcement of policies and regulations in the agriculture sector on pesticide use in Trinidad and Tobago, farm workers tend to participate in risky practices which are mostly due to their perception of the absence of risks. However, where risks are perceived, preventive measures are not employed as there is the resigned acceptance by farm workers that adverse health effects are expected. Therefore, this research can be vital in the formulation of effective Extension Training and Information Services (ETIS) initiatives that may be geared towards the prevention of pesticide related illnesses (Pinto-Pereira, Boysielal & SiungChang, 2007; Baksh, Ganpat, & Narine, 2015).

This study highlights the need for the immediate protection of this particularly vulnerable occupational group and seeks to identify the behavioural patterns or common practices of licensed and waged farm (agricultural) workers that put them at risk of experiencing either acute or chronic pesticide poisoning. It also seeks to determine whether there is an association between high risk behaviours and demographic factors that influence either becoming acutely or chronically poisoned. Finally, this study seeks to determine whether differences in the factors of scale of farming activities and the permanency of pesticide applicators—self-employed versus hired farm workers—and their pesticide practices put them at risk of becoming either acutely or chronically poisoned.

The purpose of this study is to identify and assess the behaviours and common practices of waged farm workers, particularly pesticide applicator farm workers, within the county of Victoria, Trinidad and Tobago, that put them or their family members at risk of becoming acutely or chronically poisoned. Therefore, pesticide handling practices of these farm workers are to be categorized to determine whether practices are good or poor in nature.

Finally, this study seeks to determine whether the pesticide applicator farm workers socio-economic factors and also, his awareness of the dangers associated with the use of such chemicals, influences his risk-mitigating strategies employed.

2.0 Methods

The target population consisted of all persons employed on farms in Victoria County, Trinidad and Tobago as pesticide applicators. These were persons whose job included spraying for the management of pests, diseases and weeds. The population size was unknown prior to the start of the study and all efforts made to obtain post-2004 figures were unsuccessful. A sample size of 138 workers was calculated as being sufficient to estimate the proportion of workers whose pesticide application practices could be classified as poor. The inclusion criteria were (a) individuals must be an adult as defined by the laws of Trinidad and Tobago; and (b) must have been employed as an applicator for at least six months prior to the start of the study.

The study was cross-sectional and participants were selected using convenience sampling since there was no sampling framework and random sampling was not feasible. The data collection instrument was a 36-item questionnaire with six sub-item categories. Variables measured included demographic characteristics, pesticide application techniques, use of personal protective equipment and or clothing, practices related to removal of pesticide residue from body and clothing, storage of chemicals, and history of accidental poisoning. Sampling also involved using contacts—usually participants—to identify eligible participants, that is, the snow ball sampling method.

The sampled population consisted of pesticide applicators who worked in farm districts located within agricultural districts in South Trinidad. The Victoria County was chosen as the general area of study as it consisted of the highest number of farm holders in Trinidad and Tobago. Craignish Village, Princes Town, offered the second highest farm holders' population when compared to any individual location found within the twin islands of Trinidad and Tobago (Central Statistical Office, 2004). The Ministry of Agriculture and Food Production was instrumental in facilitating the study and providing useful information for determining the sample size. The Central Statistical Office (CSO) of Trinidad and Tobago assisted also in this regard.

Data were collected from October, 2014 to February, 2015 via face-to-face interviews with consenting workers at their convenience and mainly outside the work place. The written language was Standard English; however, improvisation was done by the surveyor to further facilitate smooth communication between both parties. Face-to-face interviews were preferred over self-administered questionnaires for reasons related to logistics and to some extent participants' literacy level; and the lack of adequate facilities for writing.

Data were analyzed using SPSS version 20, and both descriptive and inferential statistical methods were used to analyze the data. Descriptive methods included frequency tables for displaying distribution of demographic and selected independent variables, and summary statistics (means). Each of the risky practices were assigned scores that reflected the degree of risk involved and the total score for each risk category was used to determine the degree of risk associated with the particular behaviour. Risk scores were then categorized to reflect poor pesticide handling practices or good pesticide handling practices. Chi-square tests were then used to test for association between demographic factors and other dependent variables and risk levels.

A one-way analysis of variance (one-way ANOVA) was then used to compare the means of the samples thereby determining the total variation between and within the groups. It was used to determine if there were any significant differences between the means of the independent variables status of employment, scale of farming activities and several assigned poor pesticide handling practices such as application techniques, consumption practices, workers' hygiene and storage.

3.0 Results

3.1 Demographic Characteristics of Participants

A total of 97 usable questionnaires (out of 138) were received by the closing date for data collection, resulting in a response rate of 70.3%. The reliability of the instrument was 0.75. Table 1 shows the frequency distribution of selected demographic characteristics of participants. As seen in Table 1, participants were primarily male (84.5%) when compared to that of female (15.5%).

Formal education among the farmers ranged from a few participants indicating that they had no formal schooling, to some participants possessing a Master's Degree. Three (3.1%) of the participants indicated that they had not attained any level of formal education, with 23 (23.7%) having primary, 46 (47.4%) attained passes at secondary level, 11 (11.3%) at technical vocational level and finally, 14 (14.4%) at tertiary level.

Self-employed farmers represented 61.9% of the participants or 60 persons, with the other 37 participants (38.1%) being hired workers. Of those employed in the farming industry, 48.5% of the participants were permanently employed as pesticide applicators while 51.6% were employed on a part time or seasonal basis. It was also revealed that 23.7% of the participants worked solely as pesticide applicator farm workers, while 76.3% held more than one job, including pesticide application.

The largest proportion of pesticide applicators, that is, (44.3%) reported handling pesticides over 10 years. The second highest proportion was pesticide applicators who have worked for more than 5 years, but less than 10 years. This group consisted of 21.7% of the total participants. Workers who were employed as applicators for periods less than 1 year and more than 1 year but less than 5 years represented 18.6 and 15.5% respectively. Of the 97 participants of the study, 5.2% stated that pesticide application activities made up to approximately 25 to 49 % of their monthly gross income, 24.7% stated that it made up 50 to 74% and finally, 70.1% stated that it exceeded 75 %.

Table 1. *Demographic Information of Pesticide Applicator Workers who Participated in the Study (n=97)*

Variable	**n**	**%**
Gender		
Male	82	84.5
Female	15	15.5
Education		
None	3	3.1
Primary	23	23.7
Secondary	46	47.4
Tertiary	14	14.4
Technical/Vocational	11	11.3
Capacity of Employment		
Self employed	60	61.9
Hired Worker	37	38.1
Status of Employment		
Permanent	47	48.5
Seasonal	50	51.6
Number of jobs		
Pesticide Applicator only	23	23.7
Pesticide Applicator and others	74	76.3
Length of time		
Less than one year	18	18.6
Less than 5 years	15	15.5
Less than 10 years	21	21.7
More than 10 years	43	44.3
Contribution to Gross Income		
less than 25%	0	0.0
25-49%	5	5.2
50-74%	24	24.7
75% and over	68	70.1

3.2 The Categorization of Risky Practices of Participants

The frequencies of participants who regularly engaged in risky pesticide practices are represented in Table 2. A scale was then formulated in which favourable or good practices were given the lowest score possible, that is, zero. As a participants' practice became riskier there was an arithmetic progression of the assigned scores—with a common difference of 1—, thus, the larger the number, the worse his practices were deemed.

The results showed that all of the participants regularly engaged in the risky practice of not using automated equipment to mix their chemicals. Also, all of the participants also stated that they did not use mechanized aids such as tractors to disperse the chemicals. They opted for riskier practices that involved close contact with these harmful pesticides.

It was noted that 32.0% of the participants were engaged in the daily use of pesticides. A total of 50.5% of the participants stated that they often applied chemicals for continual periods exceeding 30 minutes, per application. Eighty-one percent of the participants indicated that they rarely or never read the instructions printed on the labels thoroughly before each application. Consequently, 52.6% reported that they often use more than the recommended dosages for dilution.

When it came to hygienic practices, a total of 68.0% participants indicated that they often delayed the washing of their persons upon making contact with chemicals. The lack of sanitization of one's personal protective equipment also had similarly poor positive responses, as 67.0% participants engaged in this risky activity.

Fortunately, few participants engaged in risky consumption practices such as eating or smoking while applying pesticides (0.0% and 2.1% respectively). Also, few participants engaged in high risk activities such as mixing the chemical concoctions with their hands. Only 2.1% of the participants claimed to have done this.

Table 2. *Frequencies of Risky Behaviors among Participants*

Behavior	**N**	**%**
Daily pesticide use	31	32.0
Continuous spraying more than 30 minutes	49	50.5
Never or rarely reading of labels before application	79	81.4
More than the recommended pesticide used in dilution	51	52.9
Occasionally mixing with hands	2	2.1
Always or occasionally mixing with stick	37	38.1
Mixing by the Agitation of container	64	66.0
The lack of use of automated/ mechanical equipment	97	100
The application of chemicals with a Bucket and Dipper	16	16.5
The frequent use of Hand operated Hydraulic sprayers	52	53.6
The frequent use of Power-operated hydraulic sprayers	4	4.1
The lack of the Tractor-assisted application method technique	97	100
The delayed washing of one's person after chemical contact	66	68.0

Table 2 continued.

Behavior	N	%
Occasionally drinking while handling pesticides	16	16.5
Sometimes smoking while handling pesticides	2	2.1
The absence of protective boots	12	12.4
The absence of protective goggles	92	94.8
The absence of Face Guard	86	88.7
The absence of Respirators	72	73.2
The absence of Gloves	64	66.0
The absence of Coverall	46	47.4
Storage of PPE indoors	30	30.9
The lack of sanitization of Personal Protective Clothing after each use	65	67.0
Sanitization of Personal Protective Equipment among other clothing	1	1.0
The storage of left over pesticides after application	31	32.0
Storage of leftover pesticides in inappropriate containers	28	28.9

3.3 Frequencies of Risky Practices of Participants

Table 3 summarizes the frequencies of the risky practices of participants to determine the relevant risk factors for becoming poisoned. For the risk factor subcategory ‘pesticide application and mixing techniques’, a total practice score rating of 23 was calculated. Participants were considered to have poor practices if their practice scores exceeded 12. In this study, 16.5% of the participants were seen to have poor practice score ratings as they exceeded the threshold value of 12, whereas, 83.5% were seen to have good practices as their cumulative ratings were below 12.

For the subcategory ‘consumption practices’, a total practice score rating of 6 was calculated for participants were considered to have poor practices if their practice scores exceeded 3. None of the participants were seen to have poor practice score ratings as they did not exceed the threshold value of 3. Therefore 100% of the participants were seen to have good consumption practices.

For the subcategory ‘hygienic practices’, a total practice score rating of 10 was calculated. Participants were considered to have poor practices if their practice scores exceeded 4. Twenty-seven (27.8%) participants were seen to have poor practice score ratings as they exceeded the threshold value of 4, whereas, a total of 70 (72.2%) participants were seen to have good hygienic practices.

For the subcategory ‘storage’, a total practice score of 10 was calculated, where participants were considered to have poor practices if their practice scores exceeded 4. Thirty-four (35.1%) of the participants were seen to have poor practice score ratings as they exceeded the threshold value of 4, when compared to 63 (64.9%) who had ratings below 4.

Finally, for the subcategory 'personal protective equipment and or clothing', a total practice score rating of 12 was calculated. Participants were considered to have poor practices if their practice scores exceeded 5. Forty-nine (50.5%) of the participants were seen to have poor practice score ratings as they exceeded the threshold value of 5. Good practice score ratings on the other hand, had a total of 48 (49.5%) participants, as their scores were below the threshold value of 5.

For the 'total practice score rating', each subcategory's good practice score ratings were then calculated via the summation of the individual categories. Participants were considered to have poor practices if their practice scores exceeded 23. Forty-seven percent of the participants were seen to have poor practice score ratings as they exceeded the threshold value of 23 compared to the 51 (52.6%) participants who had a practice score rating less than the threshold value of 23.

Table 3. *Frequencies of the Practice Score Ratings for the Various Behavioral Practice Subcategories*

	Table of Frequencies (n)	
Practice Score Rating	**Good Practice Score**	**Poor Practice Score**
Pesticide Application & Mixing Techniques	16	81
Consumption Practices	97	0
Hygienic Practices	70	27
Storage	63	34
PPE Use	48	49
Total Practice Score	51	46

3.4 Association Between Demographic Factors and Risky Practices

The p-values calculated in Table 4 show that the demographic factors and the risk factor for poor hygienic practices were all greater than p critical value ($p>0.05$). Therefore, we concluded that there was no relationship between hygienic practices and one's demographic factors as hygienic practices were poor across the board.

The p-values calculated for demographic factors and the risky practice of not reading instructions showed that for several of the demographic factors such as gender, capacity of employment, status of employment, length of time practicing farming, number of jobs, and the percent contribution to one's gross income, they were all greater than the critical p-value ($p>0.05$). Therefore, there was no relationship between the lack of reading of instructions and one's demographic factors as they were all equally at risk. However, relationships were seen in one's education level and the scale of farming activities as they both had tabulated p-values less than the critical p-value of 0.05 ($p<0.05$) with values of 0.017 and 0.002 respectively.

The p-values tabulated for demographic factors and the usage of stronger than recommended dosage showed that for several of the demographic factors such as gender, education, capacity of employment, status of employment and the percent contribution to one's gross income, they were all greater than critical p-value (p>0.05). Therefore, there was no relationship between the use of stronger than recommended dosage and one's demographic factors as they were all equally at risk. However, relationships were seen in one's scale of farming activities, length of time practicing farming and the number of jobs a farm worker held as the p-values were less than the critical value (p<0.05) with values of 0.042, 0.006 and 0.000 respectively.

Finally, the p-values tabulated for demographic factors and poor mixing techniques showed that for several of the demographic factors such as gender, education, capacity of employment and the percent contribution to one's gross income, they were all greater than critical p-value (p>0.05). There was no relationship between poor mixing techniques and one's demographic factors as they were all equally at risk. However, relationships were seen in one's status of employment, scale of farming activities, length of time practicing farming and the numbers of jobs a farm worker held as the p-values were less than the critical value (p<0.05) with values of 0.001, 0.004, 0.011 and 0.025, respectively.

Where differences between the groups were much larger than differences within each of the groups, we concluded that the means were not the same. The null hypothesis was rejected where the test statistic p-values were less than the p critical value (p>0.05) which meant that there were significant differences between the test statistics and an increased likelihood of individuals becoming either acutely or chronically poisoned. Personal Protective Equipment (PPE) usage was revealed to have differences, as variations were evident in both the scale of farming activities as well as the status of the farm worker employment. A difference was also noted to occur among the various scales of farming activities as it related to chemical and PPE storage.

Table 4: Test of Association with Demographic variables and Risky Practices: p-values*

Variable	**Hygienic Practices**	**Lack of reading instructions**	**Stronger than recommended doses**	**Poor Mixing Technique**
Gender	-	-	-	-
Education	-	0.017	-	-
Capacity of Employment	-	-	-	-
Status of Employment	-	-	-	0.001
Scale of farming activities	-	0.002	0.042	0.004
Length of Time	-	-	0.006	0.011
Number of Jobs	-	-	<0.001	0.025
Contribution to gross income	-	-	-	-

*p-value <0.05 indicates significant association -: p-value >0.05 indicates no association

In Table 5, where the tabulated p-values were greater than the critical value ($p<0.05$) there were no significant differences between the scale of farming activities each pesticide applicator worker was engaged in, his status of employment and the practices employed that would increase the likelihood of him becoming either acutely or chronically poisoned. Both the status of employment and the scale of farming activities had no bearing on the safety practices engaged in as they related to ‘application techniques’, ‘consumption practices’ and ‘hygienic practices’ as their p-values were greater than the critical value and therefore there were no significant differences in their pesticide applicators’ approach.

Table 5. *One-way analysis of variance (ANOVA) for risky pesticide practices subcategories and demographic factors*

	Factors (p)	
Variable	**Status**	**Scale**
Application	0.228	0.185
Consumption	0.051	0.129
Hygiene	0.808	0.354
Storage	0.091	≤ 0.001
PPE Usage	0.001	≤ 0.001
Practices	0.05	0.39

4.0 Discussion

In this study, several risk factors for becoming either acutely or chronically poisoned through exposures to pesticides were examined. It was revealed that several of the participants engaged in risky activities. Among workers, activities such as the delayed washing of one’s person were observed. Das, Steege, Baron, Beckman and Harrison (2001) highlighted in their study, that generally there was a lack of compliance with the field sanitation standards as it relates to the provision of separate wash water and toilets facilities for agricultural field workers—44.1% and 28.2% prevalence respectively. This trend was also revealed in this study as 66% of the field workers indicated that they had either delayed the washing of their persons after accidental spills until the job was completed, or, washed their persons only after they exhibited signs or felt symptomatic after exposures.

Field workers, especially those of large-scale farming operations indicated that the lack of adequate facilities to wash both their persons and equipment in the event of accidental exposures was the primary reason for their delayed reaction. Additionally, workers were sceptical whether their faint ill-feelings and sensations were a result of exposures. Both large-scale and small-scale field workers were equally engaged in this poor pesticide practice.

The use of PPE while workers handled chemicals was also examined. All the participants indicated the use of at least one form of personal protective clothing and equipment during the handling of pesticides. This practice was informally attributed to their self-awareness of the hazards involved as well as training and or media (pamphlets) received on pesticides. The one-way analysis of variances

(ANOVA) test performed indicated that there were significant differences between PPE usage, and both the scale of farming activities, as well as, the status of the farm workers' employment.

This expected outcome of a farm workers' employment status may be attributed to the fact that permanent employees tend to be on the receiving end when it comes to the distribution of work resources. Permanently employed workers offer greater stability to their employers as their tenure would be long-term. Employers benefit greatly from the infrequent need for newly recruited workers, as monies would only be spent on maintenance and or the sporadic replacement of defective gear rather than the frequent purchasing of protective gear for short-term workers. As a result, permanent employees tend to have more of the PPE required to do the job. This is especially true for large scale operations.

Due to the scale of this agricultural activity, the number of pesticide applications needed to complete the task is substantial. Additionally, the period needed to complete the job is far greater than that of smaller scale farming operations. This would ultimately result in the farm workers repeated exposure over lengthy periods. In attempts to safeguard workers from repeated exposures personal protective clothing may be disbursed. For smaller scale farm workers, especially hired or temporary workers, repeated exposures to treated field may not have been as thoroughly scrutinized as in larger operations. Consequently, these workers may be in receipt of limited protective clothing and or devices.

The amount of personal protective clothing used by participants is a direct indicator of actions taken to reduce pesticide related symptoms and is therefore considered to be a pesticide risk averting behaviour (Maumbe & Swinton, 2003). However, only 2.1% of the participants wore all six items at a given time. This proportion was also identical for the percentage of individuals who wore five items at a given time as it was also 2.1%. Only 4.1% indicated that they wore four items at a given time.

A total of 89 (91.7%) participants indicated they wore fewer than three items when they handled pesticides. It is important to note that none of the participants wore specialized clothing while handling pesticides and often improvised when they lacked a personal protective item. This was highly evident as several workers could often be seen in 'bandanas' and or jerseys—often old and torn up—for covering their faces. Field notes also highlighted that several participants substituted appropriately fitted and suited coveralls with torn trousers and long-sleeved shirts.

Strangely, only 3.1% of the respondents indicated that they were ever symptomatic while handling pesticides. Given their high levels of exposures, one would have expected a far greater proportion of pesticide-related illnesses incidence within the sampled population. The sampled populations' attempts at mitigating their exposures can be deemed unsuccessful as none of the clothing was specialized to the task at hand. Additionally, protective equipment was often substituted by ill-suited devices. It can therefore be concluded that uncertainties that symptoms were as a result of direct exposures to pesticide may have been the primary reason for the under-reporting of symptoms experienced.

Additionally, due to the wide range of pesticides and their toxicities, specificity in the categorization of acute pesticide poisoning, cases proved to be difficult. This was largely because the farm holders and workers' perception of being symptomatic can vary significantly. Also, farm workers may work for several different employers, on a myriad of crops within a short space of time, therefore making it impossible to identify the actual pesticide exposure.

It has proven to be difficult to determine whether nonspecific symptoms were in fact owed to pesticide exposure or whether they have arisen from other common environmental factors—heat illness—or if they were as a result of existent health effects (Mansour, 2004). Consequently, in the absence of certainty to exposures, farm holders and farm workers tended to reject plausibility that there was a causal link and therefore understate workplace related illnesses' incidence.

In this study, 24.7% of the participants stated they had in fact received formal pesticide application training and a total of 75.3% of the participants stated that they were visited by extension officers in their workplaces. As expected, an association was seen between farm workers' level of education and the practice of reading the pesticide labels before application. Literacy challenges among uneducated pesticide applicators pose a problem regardless of the written language on the product labels. They are unable to read the instructions which in turn have a domino effect on their risk mitigating behaviours. Illiterate pesticide applicators would also be incapable of reading the correct dosages as prescribed by the manufacturers. This may have accounted for the high percentage (52.9%) of workers utilizing a higher than recommended dosage. Baksh, Ganpat and Narine (2015) reported that farmers who were not trained on pesticide application and on the use of personal protective equipment often suffer from higher rates of occupational accidents, injuries and diseases.

Other demographic factors that were also associated with stronger than recommended dosages were the scale of farming activities, the length of time an applicator had practiced farming, and the number of jobs he currently held. Large-scale operations may be plagued with this problem as workers often have a larger surface area to apply chemicals. Measurements of these large quantities may prove to be cumbersome and therefore workers opt to forgo the proper recommended rates. Additionally, many of the workers are of the opinion that the higher the dosage the faster they would see results, and this accounts for the main reason why higher than recommended dosages are used.

Small scale farmers, on the other hand, stated their primary reason for abstaining from this practice and using the stipulated ratios of chemicals to solvent is largely because of the cost. Workers claimed that the chemicals are too expensive rather than them making a conscious attempt to safeguard their well-being. However, well-seasoned pesticide applicators may desist from this practice. This may be owed to their experiences over the years.

The scales of farming activities were also seen to have implications in the manner in which chemicals and personal protective equipment are stored. A one-way ANOVA test performed indicated significant differences were occurring among the various scales of farming. This may be owed to the amount of facilities provided on each of these farm settings. Large scale operations tend to have more amenities present on-site for workers' convenience as it relates to storage in this study. Due to the enormity of farm size, it is impracticable to store farm workers' agricultural implements off-site. Workers would be burdened with the frequent need to carry both on-site and off-site the chemicals and devices needed to complete their daily tasks. For this reason, specific store sites are strategically placed on large farms.

Conversely, due to the smaller operations undertaken by small-scale farm workers the need is diminished as workers can gain total access to this agricultural field daily.

Although, a large proportion of the participants claimed to be trained in pesticide handling this unfortunately had little bearing on their attempts to evade their chances of becoming poisoned. Workers were actively engaged in precarious activities such as the lack of use of the appropriate protective clothing. Studies revealed that the greater the number of extension meetings attended, the greater the reporting of acute pesticide related illness (WHO, 2003). Contrary to this, only 3.1% of the respondents identified and or associated exposures to chemicals on the field with that of the symptoms experienced during pesticide handling activities.

An interpretation for the lack of identification of being symptomatic when exposed to pesticides, and or the underreporting of acute pesticide cases may be that the extension meetings are not focused on risk aversion methods that would effectively safeguard the farm worker's health, but rather, it may be focused on pest eradication. The WHO (2003) indicated that the traditional extension services lack a health focus and thus urgently require reformation. The report goes on to explain that if extension training with farmers placed a greater emphasis on highlighting exposure risks and potential symptoms from exposures to pesticide, workers would have readily accepted the plausibility that there was a causal link a between symptoms expressed and exposures to pesticide.

One would have assumed that the higher the participants' level of education and his awareness of the risks involved, the more mitigating practices he will employ to avert his risks of becoming poisoned. Unfortunately, the results obtained from the participants' awareness levels were not sufficiently in-depth to draw direct inferences between risk perception and historical records of pesticide poisoning. Like previous studies done, this study also utilized an individualistic framework for examining pesticide risk perception. As a result, an analysis of individuals' training and education alone is insufficient to an understanding of how he develops risk perception (Elkind, 1993). Scherer & Cho (2003) reasoned that individuals tend to adopt the attitudes and behaviours of their respective social networks. This may have inadvertently impacted the perceptions of these individuals. Additionally, cultural beliefs as well as the lack of perceptions of control may account for workers' reluctance or inability to engage in safe work practice.

Another risk factor identified was the lack of the use of automated equipment and or machinery for pesticide mixture and also its application. This current study revealed no association between demographic variables of gender, education level, capacity of employment, and the percent contribution to one's gross income and a pesticide applicator workers' mixing and application techniques.

The predominant methods of pesticide mixing rely on manual mechanisms. Workers favoured mixing the chemicals via rigorous agitation of the container and with the use of a stick (66 & 38.1% respectively). Workers also relied on hand held operating equipment for pesticide application such as knapsack (53.6%) and to a lesser extent powered blowers (4.1%). One can only assume that the lack of automated equipment and machinery may have been due to the inability of workers to afford equipment and has therefore rendered agricultural work to be highly labour intensive.

The engagement in the risky behaviour can be said to increase ones' likelihood of becoming poisoned. This came as no surprised as studies conducted identified that those who use knapsack and hand held fixed line sprayers were at a considerably higher risk of exposure to pesticides than those who used tractors. Possible reasons include the close proximity of the chemicals with respect to the user's person. Quite often, these ill-maintained devices develop defects such as broken lines and leaking canisters. When positioned on the users' back, chances of unintentional contact due to spillage is very likely. With the use of motorized vehicles that store and disperse the chemical, the chances of accidental contact are greatly reduced.

Associations were seen in ones' status of employment, scale of farming activities, the length of time one practiced farming and the numbers of jobs a farm worker held, and a pesticide applicator workers' mixing and application techniques. A workers' permanency level can affect the risk averting measures employed (Rosiro, 2006). Workers who are permanently employed and have longevity in a position are more likely to practice safer methods as there is dependency on that task for which he is financially remunerated. Additionally, any unsafe practices that may result in debilitating injuries and or chronic illnesses are detrimental to his stability.

Hired temporary farm workers on the other hand, are more likely to engage in precarious activities as they are generally employed to offset an immediate financial need. The demographics of seasonal or temporary agricultural field workers are generally those who lack both education and finances (van Dijk, 2012). Cabrera & Leckie (2009) reiterated Vaughan's (1993) findings stating that those who seek employment as agricultural labourers are generally those who are of the opinion that their options are restricted as they are incapable of securing employment elsewhere. This can also explain why hired agricultural labourers resigned acceptance of the negative health effects associated with the use of pesticides. Nonetheless, these labourers work arduously and generally accept high risk tasks.

The number of jobs a worker has can also be related to his permanency levels. Permanency level has its advantages when it comes to completing an assigned task. If a worker is permanently employed at a farming location, he does not have to rush to complete the job within a limited time frame. Rather he is afforded the convenience of returning the next day to complete any unfinished jobs. Temporary workers on the other hand may be working on a tight schedule—both assigned and/or self-imposed. As retention as an employee at a jobsite is not promised labourers may try to increase their chances of securing another day's work.

In the absence of job security, informal and seasonal arrangements do not provide continuous cash income and therefore workers subject themselves to less than ideal conditions. Farm workers may perform duties that exceed that which was required, with disregard to their personal safety. Additionally, seasonal (casual) and or occasional farm workers may attempt to offset their dependency on farming as a major contributor to their total autonomous household income by possessing several jobs. These jobs are often labour intensive for which remuneration is incomparable.

There was a negative correlation between permanency and the risk of becoming acutely or chronically poisoned. Waged farm workers of agricultural households, are generally seen to be involved in more precarious activities than farm holders due to wage insecurities and high dependency on the employing farmer as sole provider of cash income (van Dijk, 2012). Therefore, one can speculate that the greater the hired pesticide applicator farm workers' percentage gross income received from farming, the greater the chances of becoming poisoned. However, additional tests would be needed in order to fully explore any potential relationships between the interacting variables.

Pesticide applicators who frequently work within pesticide treated areas, such as those applicators that apply on a daily basis, should be in receipt of information with regards to pesticides. These workers should receive pesticide training on specific topics in a manner that is fully comprehensible to them. A special training should be targeted towards pesticide applicators who work consecutive days within treated areas. Additionally, the training should be gender specific in order to effectively deal with the problems unique to them. Note the stipulated time frame for recipients who qualify for this training should be determined by occupational hygienists. Retraining sessions should also be offered for these individuals and must be done within a suitable time frame.

General services that should be offered to all farm workers should include, but are not limited to; personal safety training, the importance of the use of personal protective equipment and or clothing, and mechanized application techniques that would decrease the likelihood of pesticides coming into contact with workers. However, as workers may be unfamiliar with the necessary precautions to be taken, as well as the operations of these sophisticated machineries, training offered should be adept. The newly acquired knowledge and skills by farm workers should enable the efficient and safe use of these contemporary technologies.

Hazard communication training should also be stressed. Although the currently employed Globally Harmonized System (GHS) of classification and labelling of chemicals does present the information on hazards associated with each pesticide, it becomes ineffective if farmers are illiterate. Extension services should therefore offer educational campaigns about the dangers of pesticide to offset this handicap.

From the results obtained, one can see that several demographic factors were associated with some of the poor practices farm workers were regularly engaged in. The risky practice, the lack of reading instructions before application, was associated with both the demographic characteristics of education level and scale of farming activities. The demographic characteristic ‘scale of farming activities’ was associated with the lack of reading of instruction, while ‘utilizing stronger than recommended doses’ and the ‘poor mixing techniques employed’ were both associated with the demographic characteristics ‘length of time one practiced farming’ and ‘the numbers of job a farm worker held’.

Variations among the demographic factors ‘status of employment’ and ‘scale of farming activities’ were seen to have caused the differences in the use of PPE. Additionally, the variation in the scales of farming activities was seen to have caused the differences in the ways in which chemicals and ones’ protective clothing were stored. As a result, several recommendations have been put forward to effectively minimize, if not completely eradicate the likelihood of farm workers becoming acutely or chronically poisoned.

With the startling revelation of the risky practices that pesticide applicator farm workers are constantly engaged in, Extension Training and Information Services (ETIS) initiatives can now tackle the problem head on and thus effectively reduce the incidence rate of farm workers’ illnesses as their risks of becoming poisoned will be significantly reduced. This would therefore improve the efficacy of future extension programmes as the acquisition of new knowledge and skills among the farm workers would effectively allow for the efficient and safe use of contemporary technologies.

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