Promoting the use of rat traps over pesticides in Cape Town's peri-urban areas: An analysis of factors influencing rat trap adoption

Candidate: Rifqah Roomaney (RMNRIF001)

Supervisor: Dr H-A. Rother

Co-Supervisor: Prof R. Ehrlich

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DECLARATION

MPH (Epi) Mini-Dissertation

I _____ Student No._____ declare that the work that I have submitted is my own and where the work of others has been used (whether quoted verbatim, paraphrased or referred to) it has been attributed and acknowledged.

Signature: _____

Date: _____

Abstract

Rodent infestations are a common problem in low socio-economic areas surrounding Cape Town. The presence of rodents can lead to the contamination of food, damage of infrastructure and the spread of rodent-borne diseases. To control rodent infestations, people in these areas resort to the use of illegal street pesticides which can also compromise their health.

The South African Medical Research Council (MRC) supported an intervention whereby rat traps were distributed to people who took part in a baseline survey in two low socio-economic areas around Cape Town (i.e. Philippi and Khayelitsha). A follow-up survey assessed rat trap use six months later. This thesis presents the findings of the latter study.

This study was based on the hypothesis that the use of rat traps would result in the reduced use of hazardous pesticides sold on the streets of Cape Town by informal vendors. The protocol (Part A) describes the sampling methodology that was used during the intervention. The literature review (Part B) illustrates the way in which poverty creates a double burden for individuals as they manage rodent infestations through using illegal pesticides resulting in risky health exposures to rodent-borne diseases and/or acute and chronic health effects from pesticides. It also discusses factors that influence the uptake of an intervention.

The article (Part C) presents the data analysis and results of the follow-up survey. The purpose of this study was to determine whether rat traps were an appropriate intervention and to establish which factors influenced households in their choices for controlling rodents (i.e. pesticides versus rat traps). The results showed that 84% (n=146) of respondents said they would be willing to use rat traps in the future, thus showing that the traps were accepted. The use of pesticides may have decreased due to the intervention, as the prevalence of pesticide use decreased from 79% (n=137) to 35% (n=59) after the intervention. Logistic regression analysis identified the factors which influenced intentions of rodent control and the effectiveness of the traps (ability to catch rodents), being male and having a willingness to buy traps at taxi ranks were predictive factors in this regard.

The rat traps appeared to be an appropriate intervention as the traps were effective in catching rodents and may have helped to reduce the use of pesticides. Sustainability of the availability of traps needs to be achieved for rat traps to be a true alternative to pesticide use.

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I would like to thank the David and Elaine Potter Foundation for providing me with financial support over the period it took for me to complete my masters. Thanks also to the South African Medical Research Council for funding the intervention.

I would also like to thank my supervisors for their support. Dr Hanna-Andrea Rother was the principal investigator of the research project from which the data for this dissertation were used. She secured ethics approval and funding from the South African Medical Research Council to conduct the baseline and follow-up surveys. The data from these surveys were entered into EpiData by her team of data analysts. Dr Rother helped to formulate the objectives of the study and guided the protocol, literature review and article development. Prof Rodney Ehrlich was a co-supervisor and helped to refine the objectives of the research. He guided the data analysis, the presentation of the results section and responded to many queries about the structure and format of the dissertation. I would also like to thank Gemma Patten for her input and support during the process.

PART A: Protocol

1. INTRODUCTION

Health risks related to rodents and rodent control are an understated public health problem, especially in developing countries. Many countries have a long history of controlling rodents through public health initiatives and yet in recent times, rodent-related diseases have become part of the 'neglected diseases in neglected populations' (Ehrenberg and Ault, 2005). Diseases associated with rodents are often ignored as they affect the poor, do not lead to emergencies, do not need to be reported and are thus not considered to be important (Ehrenberg and Ault, 2005). Rodent infestations increase the potential of being exposed to rodent-borne diseases and pesticides – both of which can severely impact upon the health of individuals. Rodent-borne diseases and the use of pesticides to control rodent infestations are problems that should not be ignored due to the unacceptable health burden these place on poor marginalized communities.

1.1. Rodent-borne disease

Certain commensal rodents inhabit most of the world's cities (e.g. *Rattus rattus, Rattus norvegicus, Mus musculus)* and are considered important as they have a close association with humans in their homes, businesses, yards and sewers (Tobin and Fall, 2004). This close contact can result in many problems, including the direct and indirect transmission of disease from rodents to humans (Tobin and Fall, 2004; Begon, 2003). Bubonic plague (*Yersinia pestis*) is an infamous example of a disease which is indirectly spread by rodents and was responsible for millions of deaths worldwide before the 20th century (Begon, 2003). There are many other important diseases that can be transmitted by rodents. For example, a study revealed that in a sample of 200 rodents, 39% (n=78) were infected with Leptosporosis and 8% (n=16) were infected with Toxoplasmosis in an informal settlement in Durban, South Africa (Taylor, 2006). Both of these infections can be transmitted to humans and can have serious effects. Human contact with rodents is thus problematic because rodent bites not only cause pain - they also carry the risk of serious disease (Childs et al., 1998). In Cape Town, South Africa, there have been reports of large rodents biting children and bed-ridden adults with devastating consequences (Cape Argus, 2003). Rat bites can cause rat bite fever (if rodents are infected with *Streptobacillus moniliformis*) although this is rare (Childs et al., 1998). These examples illustrate that the risk of disease due to rodents is a threat to many people even today, especially in

impoverished areas. As rodent infestations are common in low socioeconomic areas, rodents can put an additional burden upon the wellbeing of people who may already have a compromised health status (Battersby et al., 2002).

1.2. Problems with using pesticides for rodent control

Besides the health risks that rodents pose, people in low socio-economic areas are also exposed to risks when trying to control rodents (Rother 2010; 2008; Landrigan et al., 1999; Centers for Disease Control and Prevention CDC, 1997). People living in low socioeconomic areas are more likely to purchase 'illegal street pesticides' due to their availability in these areas and also due to a lack of awareness about the risks involved in their use. These cheap, illegal street pesticides can lead to acute poisonings and chronic health conditions due to their high toxicity (Rother 2010, Tolosana et al., 2009; Rother, 2008). The burden of exposures to toxic pesticides can be seen as a direct consequence of conditions in low socioeconomic areas which promote rodent infestations (Landrigan et al., 1999). The extent of rodent infestations coupled with the use of hazardous, illegal street pesticides represents a double burden for people in low socioeconomic areas and thus represents a serious public health problem (Rother, 2008).

1.3. Encouraging safer rodent control

To lessen the disease burden for low socioeconomic communities, the ideal situation would be to encourage the use of rodent control methods that do not require the use of pesticides e.g. rat traps (CDC, 2006; Aplin et al., 2003). Encouraging people to replace pesticides with rat traps requires that their perceptions toward rodent control change. Therefore, there is a need to understand and identify the factors that influence community members in their choice of using rat traps in order for interventions to be promoted and successful. The literature identified many factors that must be in place for people to adopt an intervention. Scott et al. (2008) identified the relative advantage of using an intervention and the observability of the result as being central to the adoption of an intervention. Palis et al. (2005) identified the effectiveness of the health interventions, the feasibility and the cost, as being important to the adoption of an intervention. Aikhomu et al. (2000) identified that prior experience and cultural acceptance would be important. Widmar et al. (2009) recognized that education and the dispelling of misconceptions was vital. Baume et al. (2009) acknowledged that adoption of an intervention would rely on the extent of the problem, whether the intervention worked and how easy it was to use. Several resource constrained communities have been successful in implementing alternative

rodent control methods (Kirsten et al., 2006; Palis et al., 2005; Belmain et al., 2003). However, these interventions were conducted in agricultural communities where the control of rodents is vital to curb the economic losses caused by rodents that damage crops (Belmain et al., 2003). Therefore these studies may not apply to urban settings.

Encouraging the use of rat traps as a safer method of rodent control could help reduce both infestations and pesticide use. This dissertation will examine whether encouraging rat trap adoption is feasible in two resource-constrained communities. It will also identify the factors that make trap adoption more likely.

1.4. Background to study

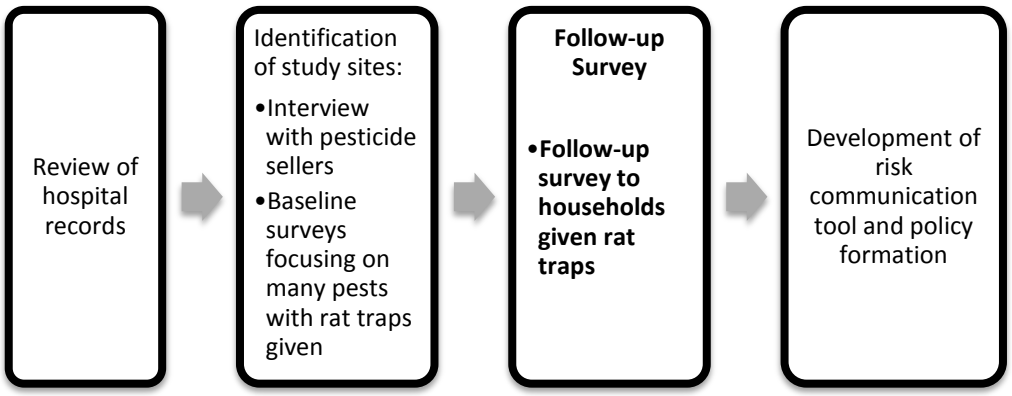
1.4.1. Context of broader study:

The data used for this dissertation were part of a larger study which was lead under the principle investigator, Dr. Andrea Rother, in the School of Public Health and Family Medicine at the University of Cape Town. The study commenced in 2006 and it sought to gain information about the use of illegal street pesticides and child poisonings that were occurring in peri-urban areas in Cape Town. It also aimed to obtain information about community willingness to use alternatives for pest control (Rother, 2006). The study methods used were as follows: Data about child poisoning were collected at a local hospital; street vendors (that sell pesticides) were interviewed and a baseline survey was administered to households (Figure 1). Each of the households participating in the baseline survey received two rat traps and a follow-up survey was administered to evaluate the use and perceptions of the traps (Rother, 2006).

1.4.2. Boundaries between dissertation and the broader project

This dissertation will mainly draw on the data obtained from the follow-up survey and will analyze the data. This dissertation will focus on rodents (whereas the broader project focused on many pests). The data from the street vendors and child poisonings will not be used. Figure 1 shows that the dissertation deals with one aspect of the broader project – the follow up survey (shown in bold on the Figure 1).

Figure 1: Broader study that dissertation is based on



1.5. Gaps in the literature

Studies that assess rodent control interventions focus predominantly on rural farming communities. The factors identified for adopting alternative rodent control in rural communities are not necessarily applicable to the context of low income urban communities. Thus there is a gap in the international literature about the factors that influence people in adopting a trapping intervention related to rodent infestations in urban areas.

Any rodent control intervention conducted in South Africa should also attempt to reduce the amount of illegal pesticides used in urban communities. Currently little literature exists about the use of illegal street pesticides (especially in developing countries) and consequently, little information exists about trying to reduce the use of these substances. Thus there is another gap in the literature as few studies assess how to best reduce the use of illegal street pesticides by encouraging the adoption of a safer method. This dissertation will contribute to the literature by identifying obstacles and facilitators to implementing a rodent control intervention that is aimed at reducing pesticide use in urban, low income communities.

2. RESEARCH AIM AND OBJECTIVES

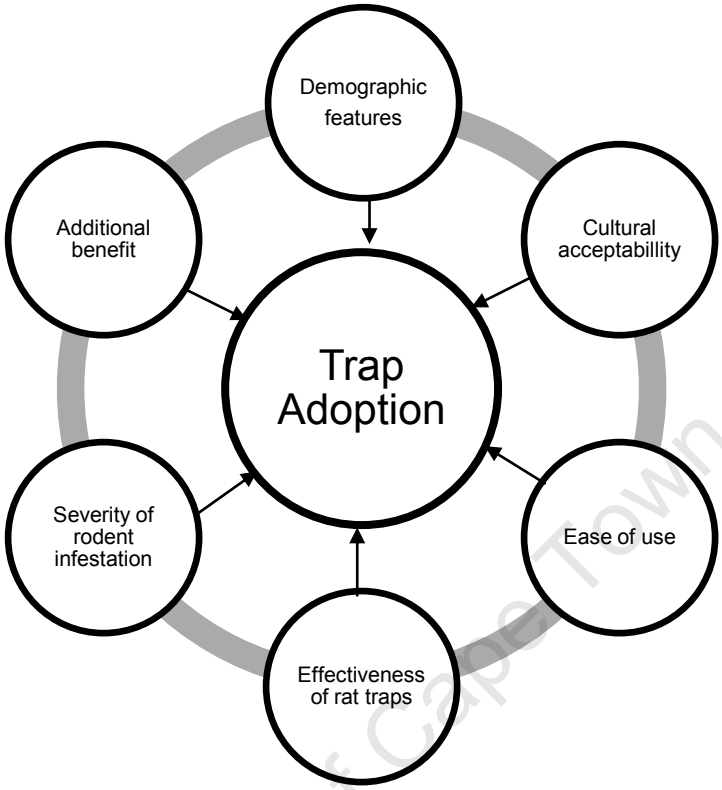
2.1. Research Aim

The aim of this dissertation is to determine whether people in two urban, low socioeconomic areas, used the rat traps that were given to them and whether the intervention influenced the type of rodent control they intend to use in the future. Furthermore, it aims to identify factors which influence choices for controlling pests.

2.2. Hypothesis

In this study it is hypothesized that encouraging the use of rat traps will lead to a decrease in the use of illegal street pesticides. Various factors influence whether people adopt rat traps and forego illegal street pesticides for rodent control. Few studies have examined the use of rat traps instead of pesticides and thus some of these factors have been taken from other health intervention studies, the Health Belief Model and the Diffusion of Innovation Theory (Baume et al., 2009; Scott et al., 2008; National Cancer Institute, 2005). According to these theories, an intervention might be influenced by whether 1) it was effective, 2) easy to use, 3) there was an additional benefit to using it, 4) the intervention was culturally acceptable, 5) the extent of the problem (i.e. rodent infestation) and 6) by the demographics of individuals (ie. gender) (Figure 2). Saving money by using traps instead of continually buying pesticides could be viewed as an additional benefit of using the intervention. Cultural acceptance is evaluated by the past use of traps, as the intervention may be acceptable if it was used in the past. The extent of the rodent infestation may affect whether the use of the traps is necessary. Demographic features may also influence the use of the traps. Additional factors may emerge when the data are analysed. Figure 2 is a summary of the hypothesized factors that may affect trap adoption and how these factors may be interlinked.

Figure 2: Hypothesized factors influencing rat trap adoption



2.3. Specific Objectives

- To determine what proportion of participants used the rat traps.
- To determine what proportion of participants intend to use rat traps or pesticides in future.
- To identify factors associated with participants' intention to use traps in the future.

Table 1 summarizes the objectives and data from the follow-up survey that will be utilised to answer each research question.

Table 1: Objectives and data required

Objective	Data Required	Question in survey
Determine proportion of participants who used the rat traps	Information on whether participants still used rat traps and bought any rat traps	Q5) Have you bought any rat-traps since May? Q6) Have you used the rat traps since they were given to you?
Determine proportion of participants intending to use rat traps or pesticides in future	Information on whether participants intend to use rat traps or pesticides in future	Q15) Will you continue using traps for controlling rats or mice? Yes or No? Q16) Will you continue to use pesticides (poison / medicine / chemicals) bought at shops or taxi ranks to kill rats and mice?
Identify factors associated with participants' intention to use traps in the future	Intention to use rat traps (outcome)	Q15) Will you continue using traps for controlling rats or mice?
	Effectiveness of rat traps	Q7) Did the traps catch any rats or mice?
	Easy to use	Q12) Did you have problems or difficulties using the traps? Q13) What did you like about the traps? Q14) What did you not like about the traps?
	Additional benefit	Q9) Are you still using pesticides to kill rats or mice? Q18) Which is more expensive, rat traps or pesticides per month?
	Past use of traps	Past use of rat traps will be ascertained from the baseline survey
	Severity of infestation	Q20) Are rats and mice still a problem?
	Demographic characteristics	Q1) Age Q2) Gender

3. METHODS

3.1. Study design

The datasets that will be used for this dissertation are derived from a cross-sectional baseline survey and a follow-up survey carried out from April - May 2009. In the baseline survey, 199 face to face interviews were conducted in IsiXhosa by trained community fieldworkers in Philippi (n=100) and Khayelitsha (n=99). All households that completed the baseline survey were given two rat traps and instructed on how to use these by the fieldworkers. After a six month period (November 2009), a follow-up survey was conducted with the same households to assess the use of the rat traps. This dissertation will mainly draw on the latter survey.

3.2. Study population and sampling

3.2.1. Exclusion criteria

Individuals under the age of 17 years were excluded from taking part in the study. Participants included in the follow-up study were consenting adults who participated in the baseline survey.

3.2.2. Study location

Khayelitsha and Philippi are large, impoverished areas in Cape Town and they are representative of many similar areas combining formal land and informal settlements. The census will be used to give a description of the areas chosen although it is likely that it is out-dated.

Khayelitsha

Khayelitsha is a suburb located on the Cape Flats in Cape Town and Khayelitsha Site C was sampled for this study. The total population of ward 90 (which includes Khayelitsha Site C and Khayelitsha T1 V4) is about 23 358 (City of Cape Town CCT, 2006) but this is likely to have increased. According to the Khayelitsha Development Forum (KDF, 2006), informal housing makes up 52% of the area. Unemployment is high amongst the economically active age group (15-65 years) with 24% of males and 30% of females being unemployed (City of Cape Town CCT, 2006). Of those that are working, 86% of households had a monthly income of less than R1600 (CCT, 2006). In this settlement, 47% of dwellings had access to electricity but slightly

more were using paraffin (CCT, 2006). Also, only 3% of dwellings had access to water inside the dwelling which shows that a large number of dwellings used either communal taps (24.5%) or had taps in their yards (25.6%) (CCT, 2006).

Philippi

Philippi East is also located on the Cape Flats and it forms part of Ward 35 (along with Klipfontein, Lower Crossroads, Luzuko, Mandalay, Philippi Industrial and Thabo Mbeki) (CCT, 2006). Philippi is one of the largest townships in Cape Town (South African Environmental Project SAEP, 2009). The total population of this ward is about 28,812 people (CCT, 2006) although the SAEP (2009) claim that for the whole area it is closer to 110, 321 people. Formal dwellings make up more than half of this area (68.5%). Unemployment is also high - with 23% of males and 28% of females being unemployed. Of those that are working, 54% of households earn less than R1600 monthly (CCT, 2006). With regards to services, 96% of dwellings had access to electricity and 30% had access to piped water inside the dwelling. These figures appear to be slightly better than those for Khayelitsha.

3.2.3. Sampling strategy

These study sites were chosen as these areas had the most children admitted to a local hospital for poisonings by illegal street pesticides (Rother, 2006). Ward councillors were contacted in order to have permission to conduct the study in those wards. Community centres were used as the reference point and fieldworkers walked down the main street until they found houses marking the first residential area. The first house was counted and every tenth house or dwelling from there on was interviewed. If no one was home to answer the survey, the next house was surveyed. This type of sampling was done because informal settlements grow very rapidly and it is therefore very difficult to find a list of all the informal dwelling addresses. The strategy used in the follow-up survey, was to find each dwelling that had been surveyed in the baseline survey. Fieldworkers were given household names, addresses, and any other identifying factors (i.e. occupation) that could help them to locate the households that were interviewed in the baseline survey.

3.2.4. Fieldworkers

Relevant ward councillors identified community fieldworkers to administer the baseline survey (Rother, 2006). Fieldworkers were trained on how to administer the surveys and participants were asked to sign consent forms before being interviewed.

For both surveys, fieldworkers interviewed participants in their home language by reading them the question from the survey and writing down their response.

3.3. Measurement

The baseline survey consisted of four main parts (Rother, 2006):

- Demographics and perceptions of pests
- Perceptions of pesticides and usage
- Exposure to pesticides and history of poisoning
- Rodent control and alternative control measures

Where necessary, this dissertation will draw on information from the sections on rodent control from the baseline survey.

The follow-up survey questionnaire can be found in Part D (the Appendix). The follow-up survey was much shorter than the baseline survey - featuring 25 questions, starting with the location, address and demographic details of the participant. Demographic data were also included in the follow-up survey in order to link those data to the individual who was responding and thus linking their perceptions to that individual and not only the household (for example, if a different person in the household answered the follow-up survey). The survey then questioned how many rat traps were used on the property and if the respondents were using the traps that were given to them. The efficiency of the rat traps was questioned, such as how well they worked; if they were easy to use; if they caught any rodents; and what people liked and disliked about them. Behaviour change was assessed by asking whether participants still used street pesticides for rodent control. Participants were then questioned on whether they would buy more rat traps and how much they were willing to pay for it. Questions about income and expenditure were included in the follow-up survey as the questions were not answered well in the baseline survey.

3.4. Potential limitations

The dissertation is limited at the outset, in that it takes information from a study that was already completed and therefore sample size and questions asked in the survey were determined before the dissertation was proposed. Desirability bias may be an issue in the surveys as respondents may answer in a particular way as they feel those are the answers that the interviewers wanted to hear. To minimize this bias the

interviewers were trained so that they would not prompt the respondents. Knowing that there was a follow-up survey might have lead to people changing their behaviour with regard to their use of the rat traps. However, respondents were not aware that they would be interviewed again (after the rat-traps were given to them).

3.5. Pilot sampling

For the baseline study, surveys were piloted amongst several residents. Surveys were then adjusted, translated and back-translated to make them more appropriate. For the follow-up survey, two households in the original sample were supposed to be surveyed in the pilot. However, four houses from the original survey were accidentally sampled. These four records will be excluded from the data analysis as additional questions were added after the pilot study.

3.6. Logistics and time schedule

MONTH	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Literature Review												
Data Management												
Data Analysis												
Results												
Discussion/ Write- up												

The schedule for this dissertation is to hand in by the February 2011 deadline.

3.7. Data management and analysis

3.7.1. Data management

Some questions in the follow-up survey were open ended whilst others were not. The data will be cleaned where necessary. Qualitative data will be put into appropriate categories to be further analysed. The data were entered into EpiData (version 3.1) and will be analysed using STATA 10 (STATA for Windows, version 10, Stata Corp; College Station, TX).

3.7.2. Data analysis

The statistical methods used will take into account that the data are from a survey and thus the survey suite of STATA commands will be used. Table 2 lists the types of variables that will be used.

Table 2: Types of variables

Variable name	Type of variable
Age	Numerical
Gender	Binary
Used trap	Binary
Bought trap	Binary
Intended trap use	Binary
Intended pesticide use	Binary
Traps more expensive	Binary
Past use of traps	Binary
Traps caught rodents	Binary
Past infestation	Binary
Current infestation	Binary
Liked trap	Qualitative
Disliked trap	Qualitative

For objective 1, tabulations will be done to ascertain how many people used the rat traps and to ascertain whether participants bought additional rat traps. For objective 2, intended use of traps and pesticides will be assessed through tabulations. A Chi Square test will be used to ascertain whether there is a statistically significant association between continued use of pesticides and use of rat traps (see Table 3). The prevalence odds ratio will be calculated to quantify the association. Objective 3 aims to identify factors which predict whether people actually intend to use rat traps in the future. The main outcome of interest (trap adoption) is binary and thus tabulations will be used extensively for the data exploration of categorical data.

Table 3: Dummy table for association between intended trap and pesticide use

	Intended trap use	No intended trap use	Total
Intended pesticide use			
No intended pesticide use			
Total			

Associations between categorical variables and the outcome will also be tested using Chi-square tests (see Table 4). Most of the data are categorical but there are a few numerical variables and thus boxplots will be used to test the association between numerical variables and the outcome.

Table 4: Dummy table example for variables that may be associated with intended trap use

Variables	Response	Intended trap use (%)
Current pesticide use	Yes	
	No	
Traps more expensive	Yes	
	No	
Past use of traps	Yes	
	No	
Traps caught rodents	Yes	
	No	
Current infestation	Yes	
	No	

Multivariate logistic regression will be conducted to assess which factors are associated with the outcome of whether people intend to use traps or not, adjusting for other factors. Stepwise regression will be used to identify which variables are associated with the outcome on statistical criteria (ie. a “prediction model”). As the survey commands in STATA do not support model building (no Likelihood Ratio tests can be done), the model building will take place in standard STATA. Once the model is built, it will be used to assess the data in the survey suite. The results will then be compared to the factors identified by the literature. Table 5 gives a summary of the statistical tests that will be used.

Table 5: Objectives related to data analysis

Objective	Question in survey	Statistical Analysis
Determine proportion of participants who used the rat traps	Q5) Have you bought any rat-traps since May? Q6) Have you used the rat traps since they were given to you?	Tabulations
Determine proportion of participants intending to use rat traps or pesticides in future	Q15) Will you continue using traps for controlling rats or mice? Q16) Will you continue to use pesticides (poison / medicine / chemicals) bought at shops or taxi ranks to kill rats and mice?	Tabulations Chi Square Test
Identify factors associated with participants' intention to use traps in the future	Q15) Will you continue using traps for controlling rats or mice? (Outcome)	Tabulations Stepwise selection using logistic regression
	Q7) Did the traps catch any rats or mice?	
	Q12) Did you have problems or difficulties using the traps? Q13) What did you like about the traps? Q14) What did you not like about the traps?	
	Q9) Are you still using pesticides to kill rats or mice? Q18) Which is more expensive, rat traps or pesticides per month?	
	Past use of rat traps will be ascertained from the baseline survey	
	Q20) Are rats and mice still a problem?	
	Q1) Age Q2) Gender	

4. ETHICAL CONSIDERATIONS

All participants completed a consent form before the survey was administered (see Appendix Part D) and received some benefit (by receiving free rat traps). There may be some unintended consequences in people having accidents with rat traps (getting a finger caught in it for example) but this will form part of assessing whether the intervention is appropriate.

The study was granted ethics approval by UCT on 10th of October 2005. The study was funded by the South African Medical Research Council (REC REF: 375/2005). The ethics approval can be found in Part D (the appendix).

5. DISSERTATION STRUCTURE

This dissertation will consist of four parts:

A) Protocol
B) Literature review
C) Article
D) Appendices

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7. ACRONYMS AND ABBREVIATIONS

AIC	Akaike information criterion
CCT	City of Cape Town
CDC	Centers for Disease Control and Prevention
CI	Confidence interval
CTBS	Community trap barrier system
EPB	Environmental Protection Bureau
HBM	Health belief model
HSRC	Human Sciences Research Council
IPM	Integrated pest management
JEHR	Journal of Environmental Health Research
KDF	Khayelitsha Development Forum
LR	Likelihood ratio
MRC	South African Medical Research Council
NCI	National Cancer Institute
NGO	Non-governmental organization
OR	Odds ratio
PE	Port Elizabeth
SA	South Africa
SAEP	South African Environmental Project
UCT	University of Cape Town
UK	United Kingdom
US	United States

8. DEFINITIONS

- *Illegal Street Pesticide*

"Pesticides (predominately registered for agricultural uses) that are decanted (i.e. into used drink containers or medicine bottles), and sold unlabelled for unregistered uses (primarily domestic pest control) at train stations, taxi stands, on trains, and door-to-door" (Rother, 2010, p.202).

- *Integrated Pest Management (IPM)*

IPM involves improving sanitary and structural conditions in order to deny pests' entry and access to food and water. It also recommends the cautious application of pesticides if necessary (Kass et al., 2009).

PART B: Structured Literature Review

1. INTRODUCTION AND OBJECTIVES OF LITERATURE REVIEW

Rodent infestations are an overlooked public health problem in many low socioeconomic areas in South Africa. Rodents create numerous problems because they contaminate food, transmit diseases and can reduce the quality of life of individuals (Centre for Disease Control CDC, 2010). Pesticides are used globally to manage rodent infestations and people in low socioeconomic areas (particularly in developing countries) often resort to the use of 'illegal street pesticides' to manage infestations, even though the exposure to these can lead to serious health effects. People in these areas face a double health burden as rodent-borne diseases and pesticide exposures can threaten their wellbeing. Alternative rodent control could be used to decrease rodent populations, the demand for pesticides and the consequent health risks. Promoting the use of alternative rodent control methods however, requires individuals to change their preferred pest control method as they may be accustomed to using pesticides. This dissertation investigates the uptake of a rat trap intervention conducted in Cape Town, South Africa (SA) and the factors that influenced the adoption of this intervention. To inform this research, the objectives of this literature review were:

- to investigate whether socioeconomic status is related to rodent infestations;
- to explore illegal street pesticide usage and identify health effects related to their use;
- to identify alternative methods of rodent control and studies that have encouraged the use of alternatives; and
- to ascertain factors associated with promoting health and safety behaviour change.

2. SEARCH STRATEGY:

The following search strategy was used to inform this literature review:

***Strategy*:** Search engines were used to search for combinations of the listed search terms (below). Relevant articles suggested by search engines were followed up upon. References in articles were checked so as to identify any other relevant studies.

Exclusion criteria: Studies using rodents as lab test subjects and non-English articles.

***Inclusion criteria*:** Studies on rats, mice and other pests; studies examining health interventions; and studies on the use of pesticides in urban areas.

***Search Terms*:**

- *Rodents:* rats; mice; mouse; pests; vermin, rodent diseases
- *Poverty:* poor; urban; slums; informal settlements; inner city; infestations; environmental health; low income areas; pest infestations
- *Poisons:* pesticide; illegal street pesticide; rodenticide; aldicarb; organophosphate; health effects of pesticides; pesticide risk perceptions; poisoning; suicide
- *Rodent control interventions:* rat traps; snap traps; mechanical traps; rodent traps; mice traps; rat control; pest control in urban areas; interventions; health behaviours; factors influencing use rat traps; adopting rat traps; community rat reduction programs; behaviour change

***Search Engines*:** Pubmed; Google; Google Scholar; EBSCOhost; Science Direct; JSTOR; Swetswise; MedLine; Sabinet; Aleph (University of Cape Town library database).

3. SUMMARY OF LITERATURE REVIEW

3.1. Poverty, rodents and pesticides

People who live in low socioeconomic areas are frequently exposed to multiple situations which can threaten their health. The poor bear the brunt of ill health due to the relationship between health and wealth (Myer et al., 2004; Wood, 2003; Singh et al., 1996). Extensive research has shown that urban, low socioeconomic areas are susceptible to rodent infestations (Bonner et al., 2007; Gbogbo et al., 2007; Marshal and Murphy, 2003; Pai et al., 2003; Lambropoulous et al., 1999; Singh et al., 1996). This susceptibility is due to common conditions in low socioeconomic areas which promote pest infestations, such as blocked, open drains; uncollected solid waste; ineffective sanitation and drainage; water logging and the conduct of some individuals (Singh et al., 1996). Similar environmental health conditions exist in many parts of SA which indicates potentially widespread exposures to rodent infestations (South African Environmental Project, 2009; Ndingaye, 2005). This is demonstrated by a study done in SA which surveyed the parents of children with atopic dermatitis

(Tolosana et al., 2009). The study found that 85% (n=52) of respondents who lived in an informal settlement indicated that rats were problematic household pests (Tolosana et al., 2009). Rodent infestations and their related problems (e.g. carriers of disease, competing for limited food sources, biting and representing the social stigma of a "dirty home") are a threat for the poor (Tobin and Fall, 2004). Rodents present a health risk as they can transmit a number of diseases such as Bubonic Plague, Leptospirosis, Lassa Fever and Salmanellosis (CDC, 2010; Meerburg et al., 2010; Bonner et al., 2007, Thomas et al., 2001). It is therefore in the interest of healthy environments for the poor that rodent control is of importance in low socioeconomic areas.

Pesticides are commonly used in low socioeconomic areas for pest control due to the extensive pest infestations experienced in these areas (Kass et al., 2009; Bradman et al., 2004; Landrigan et al., 1999). Several studies have documented the high levels of pesticide exposure in low socioeconomic urban areas (Tolosana et al., 2009; Thomas et al., 2001; Landrigan et al., 1999). A survey done in Port Elizabeth, SA, noted that lower socioeconomic households tended to spend more on pest control measures than higher socioeconomic households (Thomas et al., 2001). High levels of pesticide exposure were also demonstrated in the Tolosana et al. (2009) study where 89% of the study children (n=61) in two South African informal settlements were exposed to pesticides at home. This high level of pesticide exposure is of public health concern due to the potentially severe ailments that can result from them.

3.2. Health effects of pesticides

It is well documented (especially in agricultural regions) that exposure to pesticides can lead to both acute poisoning and chronic health effects (Jensen et al., 2011; Lee et al., 2010; De Silva et al., 2006; Jors et al., 2006; Kishi, 2005; Kamel and Hoppin, 2004). Some health effects associated with pesticides such as cancer, asthma, hormone disruption and neurological effects are well documented (Cohen, 2007; Salam, 2004; Landrigan et al., 2001; Weis et al., 2004; Zahm and Ward, 1998; Colborn et al., 1993; National Research Council, 1993). The health effects of agricultural pesticides are relevant to urban areas because many of the available illegal street pesticides are sourced from the agricultural sector (Rother, 2010). One study showed that 88% (n=78) of pesticide sprayers who worked on farms in Cambodia, experienced symptoms of acute poisoning due to inadequate safety equipment in the month before the study took place (Jensen et al., 2011). Studies

performed in urban areas have also revealed some of the health effects associated with pesticide exposure (Julien et al., 2008; Whyatt et al., 2004; Berkowitz et al., 2003; Perera et al., 2003). Perera et al. (2003) investigated pesticide (specifically, insecticide) exposure in a cohort of pregnant women in New York, United States (US) and found that prenatal exposure to chlorpyrifos was associated with lower birth weight and decreased birth length. Based on the same cohort, Whyatt et al. (2004) also showed that prenatal exposure to pesticide was associated with impaired foetal growth.

Children are considered most vulnerable to pesticides for many reasons relating to their physiology and exposure behaviours (Goldman, 2004; Landrigan et al., 2001). Systematic reviews and other studies show that exposure to pesticides during sensitive periods of childhood may lead to childhood leukaemia, differences in the onset of puberty, impairments of the neurodevelopment process, intracellular genetic damage and cognitive impairment (Tolosana et al., 2009; Jurewickz and Hanke, 2008; Eskenazi et al., 2007; Sanborn et al., 2007; Marshall et al., 2008). Women in developing countries are also vulnerable to the effects of pesticide. For example, women often occupy the most marginal positions in the workforce (London et al., 2002).

3.3. Illegal street pesticide use

People in low socioeconomic communities regularly use illegal street pesticides to control their infestation problems (Rother, 2010; Julien et al., 2008; Vates and Osterhoudt, 2008; Byrd et al., 2007; Servamus, 2007; Environmental Protection Bureau EPB, 2002; Nelson et al., 2001; Landrigan et al., 1999; CDC, 1997; Lima and Reis, 1995). Illegal street pesticides are considered hazardous as they may contain unknown, varying ingredients; and lack clear instructions and safety warnings (Rother, 2010; Environmental Protection Bureau, 2002). Rother (2010) analyzed the composition of illegal street pesticides and found that they contained a mixture of pesticides registered for agricultural uses. These agricultural pesticides are used in small homes without proper protective equipment or the proper application equipment that would reduce exposures. Furthermore, the pesticides are bought from farm co-operatives or supermarkets, decanted into unlabelled containers and sold by informal vendors (Rother, 2010; 2008). The packaging of these pesticides increases the risk of acute poisoning as they are decanted into used bottles (e.g. juice, water, alcohol bottles) and can thus be mistakenly drunk by children (Rother, 2008). Balme et al. (2010) examined medical records at a hospital in Cape Town and showed that the incidence of pesticide poisonings appeared to be increasing (e.g.

200 cases were reported in 2003 whereas 500 cases were reported in 2008). This study may underestimate the number of poisonings that occurred as often not much time is given to accurately report cases.

Aldicarb, a carbamate, is an example of a highly toxic illegal street pesticide that is often used for rodent control in low socioeconomic urban communities (Rother, 2010; Vates and Osterhoudt, 2008; Allen, 2001; Nelson, 2001; Lima and Reis, 1995). Aldicarb is registered for use against mites; insects and nematodes - it is not intended to be used as a rodenticide (CDC, 1997). The acute toxicity of aldicarb is the highest of any pesticide still in use and is banned in the United States (Scientific American, 2010). It is classified by the World Health Organization and the Environmental Protection Agency as an 'extremely hazardous pesticide' (Class 1a; World Health Organization, 2004; Pesticide Action Network, 1998; CDC 1997). High oral doses or dermal exposure to aldicarb can be fatal to humans as it paralyses the respiratory system (EPB, 2002). Aldicarb has been implicated in numerous poisoning and suicide attempts in the United States, Brazil, Zimbabwe, South Africa and Israel (Balme et al., 2010; Rother, 2010; Caldas et al., 2008; Julien, 2008; Byrd et al., 2007; Tagwireyi et al., 2006; Landrigan et al., 1999; CDC, 1997; Lifshitz et al., 1997). A study conducted in Zimbabwe examined all cases of acute pesticide poisoning at major referral hospitals over a ten year period (Tagwireyi et al., 2006). The study noted an upsurge in the illegal sale of aldicarb which was encouraged by its availability, low cost and its effectiveness (Tagwireyi et al., 2006). This upsurge led to a rise of rodent control related poisoning (as aldicarb was used for rodent control). The study estimated that 75% of accidental poisonings due to aldicarb, occurred in children less than five years of age (Tagwireyi et al., 2006). It is possible that growing urbanization and consequent poor environmental health conditions caused the increase in demand for the pesticide but this is not elaborated upon in the study.

3.4. Non-toxic rodent control: Trapping

Owing to the hazards of pesticides, many have advocated a reduction in pesticide use (Traweger et al., 2006; Keiner, 2005; Aplin et al., 2003; Eddelston et al., 2002). There are numerous methods that can be used to reduce the use of pesticides. In the US, enforcement of legislation has reduced the availability and the use of highly toxic pesticides (Carlton et al., 2004; Nelson et al., 2001). However, relying on legislation may not be feasible in developing countries where enforcement is limited and monitoring/surveillance systems are often under-resourced (Rother, 2010; Tagwireyi et al., 2006; London and Bailie, 2001). Another method of reducing the use of

pesticides is through promoting the use of alternative pest control methods such as rat traps. Trapping is a relatively inexpensive and less complicated control method to introduce into low socio-economic communities. Traps are legal, they produce quick results and rat carcasses can be located and disposed of immediately which prevents odour problems (China Food and Environmental Health Department, 2009). Traps are useful when more efficient methods are unavailable. They are also useful in situations where there are dangers of children and pets being poisoned (Kirsten et al., 2006; Tobin and Fall, 2004). In areas where rodents are consumed by humans, traps are used extensively – this is because poisons would make the rats unsafe to eat. Another useful scenario for rat traps is in food storage, where pesticides may contaminate food (Kirsten et al., 2006). Thus rat traps are a useful method of rodent infestation control and they could be promoted.

Not many trapping trials have been performed in urban areas. Studies from rural communities were therefore reviewed to identify findings applicable to urban communities. Kirsten et al. (2006; 2005) studied factors influencing the uptake of rat traps. A trapping trial done in KwaZulu Natal Province, SA showed that efficient and sustainable rodent control could be managed through continuous trapping (Kirsten et al., 2006). After the intervention, the traps were widely used and the demand for the traps rose (Kirsten et al., 2006). Market surveys were also done to assess changes in demands for traps. The use of the traps proved to be more cost-effective than the use of acute pesticides as farmers did not need to continually purchase pesticides. A key barrier to rat trap adoption identified was that some of the locally available traps were not strong and retailers did not have enough traps to meet the demand after the intervention (Kirsten et al., 2006). Immediate action was taken by creating and establishing links between local trap manufacturers, retail outlets and rural communities (Kirsten et al., 2006).

In Mozambique, a similar study was conducted to observe whether intensive trapping could reduce the size of the rodent population in 1200 rural households in agricultural villages (Belmain et al., 2003). Villages were selected in places where the chiefs indicated there was a rodent problem and each village was randomized to receive the intervention or be a control site (randomization was not explained in the study thus the study may be subject to bias). Every household in the intervention villages was given ten break-back traps and trained on how to use them. What resulted were fewer rodent bites and a 30-40% decrease in grain consumed and contaminated by rodents in areas with the intervention (Belmain et al., 2003). Control households had significantly higher amounts of rodents inside their homes (Belmain et al., 2003). The study found that trap adoption was based on the famers' basic understanding of

rodent biology and management as this helped to inform and motivate farmers to use non-toxic rodent control (Belmain, 2004). The study recommended that radio broadcasts be used to raise awareness and educate farmers (because of low literacy levels), thereby ensuring the sustainability of trap use (Belmain, 2004). In both these studies, intensive trapping using well designed traps helped to reduce rodent populations and proved to be cost-effective. Of relevance to urban areas is that the traps helped to reduce rodent populations, prevent rat bites and improve food security although sustainability of the use and access to traps remains a problem. Reductions in pesticide use were not evaluated in these studies.

3.5. Factors influencing health intervention adoption

In order for people to adopt an intervention, there needs to be a willingness to change current practices and behaviours – that is, promote rat traps and reduce pesticide use. Several useful theories have been proposed for assessing what makes people more likely to adopt an intervention. For this dissertation, the Health Belief Model and the Diffusion of Innovation theory have been identified as relevant for assessing factors influencing the adoption of rat traps. These models were chosen because they are well established in many fields, incorporate many factors that other rodent control intervention studies have touched upon (e.g. these models take past experience, perceived susceptibility and complexity of the intervention into account) and they appear relevant to a rat trap intervention.

The Health Belief Model states that people are willing to change, depending on:

- *Perceived susceptibility*: that they are susceptible to the condition (i.e. health effects from pesticide)
- *Perceived severity*: that the condition has serious consequences
- *Perceived benefits*: that there are benefits to changing and that taking action reduces susceptibility to condition (i.e. pesticide exposure)
- *Perceived barriers*: that the benefits of taking action outweigh the cost
- *Cue to action*: that they are prompted by some cue to take action (e.g. advert) and
- *Self-efficacy*: that they are confident that they can perform the activity without help (National Cancer Institute, 2005; Palis et al., 2006; Janz and Becker 1984).

Palis et al. (2006) used this model to show that certain misconceptions influence whether farm workers took precaution against pesticides. Similarly, if illegal street pesticide users see pesticides as dangerous, they may be more likely to use rat traps.

Rogers' (1962) Diffusion of Innovation theory identifies five attributes that affect adoption, namely:

- *Relative advantage*: that the intervention is perceived to be better than what is currently used
- *Comparability:* intervention fits with past experience and existing values
- *Complexity*: intervention is not difficult to use or understand
- *Trialability:* intervention can be tried before bought
- *Observability*: positive results from using intervention can be observed (Scott et al., 2008; Rogers, 1962).

As not many relevant rodent control studies were identified using the Diffusion of Innovation Theory, other types of health interventions were explored. The Diffusion of Innovation Theory was used to asses Scott's (2008) study about the uptake of Healthy Heart Kits (HHK), which is a tool used by health workers to promote cardiovascular health in patients through education. The study is similar in that it aimed to identify factors that facilitated the uptake of an intervention (HHK). The Diffusion of Innovation Theory may also prove useful in identifying facilitating or impeding factors in adopting a rat control intervention as it is used when new technologies are introduced to people.

One intervention study explored the improvement of a traditional rodent control method in India (Terjeson, 2007). A traditional trap known as *pot fumigation* was used to trap rodents by lighting a fire in a clay pot and smoking out a rodent burrow (Terjeson, 2007). This was dangerous (as it burned trappers' hands and mouths) so a safer trap was developed by a local engineer. This trap was constructed from steel which made direct contact with the device unnecessary and thus removed the initial danger of being burned (Terjeson, 2007). A factory was setup where young women made the improved traps so as to not interfere with the traditional hierarchy of the village (Terjeson, 2007). The traps were perceived to be more valuable when sold at an affordable price compared to when given away for free, which promoted the adoption of the intervention (Terjeson, 2007). The uptake of these interventions appeared to work because people had prior experience with them. The traps were easier to use, were safer, were not given out for free and the factory production did

not change the village's traditional hierarchy. Thus if the rat traps are found to be effective and easy to use, people will adopt the intervention.

Other studies have indicated similar factors important for behaviour change. Many factors are likely to influence the uptake of an intervention, including: product price, financial costs, labour required, environmental costs, ability to maintain social structures; increase agricultural outputs and benefits to livestock (Carlton et al., 2004; Aplin et al., 2003). Some of those factors may only be relevant to agricultural areas, as they may make an uptake of an intervention difficult in an urban area. The effectiveness, feasibility, affordability, prior experience, relative advantage and whether an intervention is culturally acceptable or not are all factors that have been identified for a successful intervention adoption (Kass et al., 2009; Scott et al., 2008; Terjeson, 2007; Palis et al., 2005; Aplin, 2003).

4. GAPS IN THE LITERATURE

The gaps in the literature have been divided into the following areas:

Rodent interventions in urban areas

Often rodent control intervention studies are conducted in agricultural regions where there are economic benefits to controlling rodents. When rodent control interventions were carried out in urban areas, they were usually in developed countries and required large amounts of resources for techniques such as integrated pest management (Kass et al., 2009). There is a lack of studies that look at low cost techniques (e.g. intensive trapping) of rodent control in low socioeconomic urban areas in developing countries. The lack of studies may indicate that rodent infestations and consequent health effects are not a high priority in the public health agenda of developing countries. The reasons for this disregard may be that rodent infestations mostly affect the poor and are not seen as an urgent health issue.

Interventions for reducing pesticide use in urban areas

Trapping interventions that have been conducted aimed to reduce rodent infestations and not pesticide use. There were no interventions identified that looked at promoting an inexpensive control method (such as trapping). Similarly, there were no interventions that assessed whether pesticide usage changed in an urban environment or not either. Limited studies do exist on the use of illegal street pesticides in poor urban areas thus information on illegal street pesticides represents a gap in the literature itself (Rother, 2010; Allen, 2001; Landrigan et al., 1999). The

use of pesticide is a concern for the public health and environmental sectors. This is because they pose a general threat to the wellbeing of the human population and cause contamination where applied. -

Reasons intervention worked

Few studies assessed what factors aid the adoption of an alternative rodent control method (Terjesen, 2007; Palis et al., 2005; Belmain, 2004). Knowledge of the factors which influence the adoption of an intervention would be valuable for informing interventions in the future.

5. NEED FOR FURTHER RESEARCH

In Cape Town specifically (and in developing countries in general), there is little known about rodent problems and the use of illegal street pesticides. This represents a problem as the health consequences could be devastating. Several rodent control interventions have been done but not many have been conducted with the aim of reducing pesticide use. Although trapping trials have been done in rural areas, these still do not appear to be done at a low cost. Furthermore, most research in urban areas has also not assessed what made these interventions appropriate. There is a need for an intervention in urban areas that objectively assesses trap use, pesticide use and rodent infestation levels. There is also a need to create awareness and publicize the problems of rodent infestations and the use of illegal street pesticide in low income urban communities.

6. CONTRIBUTION OF DISSERTATION TO LITERATURE

The information that could be gained from this dissertation is an assessment of whether rat traps are an appropriate intervention in a poor, urban setting and whether they should be advocated (by communities, government and other stakeholders) to potentially reduce the use of rodent infestations and illegal street pesticides. This proposed study is part of an intervention study done in an urban area, and focuses on behaviour changes in pesticide-users. If the intervention is found to be successful, it could have impact by adding to the literature on illegal street pesticide use, rodent infestations in South Africa and behaviour change interventions in urban areas. It would be one of the few studies that have promoted intensive trapping in an urban setting. The overall study could inform future interventions for pest control and other health interventions such as pesticide-use reduction. This study also helps to highlight the public health problem of pesticides used outside of agricultural areas.

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PART C: Article

Promoting the use of rat traps over pesticides in Cape Town's peri-urban areas: An analysis of factors influencing rat trap adoption[1]

Abstract[2]

Rodent infestations and the use of illegal street pesticides to control them are a problem in low socio-economic areas surrounding Cape Town. The presence of rodents is common in these areas and can lead to disease, contamination of food and damage to infrastructure. The use of illegal pesticides to control rodents however, can also result in various consequences that compromise the health of individuals. The South African Medical Research Council (MRC) supported an intervention where rat traps were distributed to 199 people from two low socio-economic areas around Cape Town (i.e. Philippi and Khayelitsha) who took part in a household baseline survey. A follow-up survey was conducted six months later to assess rat trap use (N=175). The purpose of this study was to assess whether people used the intervention after a six month period, whether people would use traps in the future and to identify factors that influenced their decision.

The results showed that 88% (n=154) of respondents used the traps and only 35% (n=59) were still using pesticides. Using logistic regression to analyze the follow-up survey data, a model was built to identify factors that influenced whether respondents intended to use rat traps in the future. Using a stepwise model, the analysis identified that the effectiveness of the traps (catching rodents) [POR: 14.64, 95% CI: 3.49-61.43], being male [POR: 7.02, 95% CI: 1.31-37.50], and the willingness to buy traps from a taxi rank [POR: 14.78, 95% CI: 3.32-37.5] were key factors in behaviour change toward rat trap adoption.

Overall the traps were an effective intervention for reducing pesticide use but sustainability needs to be addressed.

Key words: rat traps, illegal pesticides, informal settlements, behaviour change, health interventions, South Africa, rodent infestations, rodent related diseases.

[1] The Journal of Environmental Health Research recommends that Times New Roman Font 12, single spacing be used. For readability, Arial 11 font has been used with 1.5 spacing.
[2] Adapted from dissertation abstract (page iii)

INTRODUCTION

Rodents are both a menace and a public health problem and are capable of harming the wellbeing and livelihoods of many people. Humans have been exposed to this risk for a long time but it is now being exacerbated as the number of people living in urban centres increase (Gratz et al., 1999). Rodent infestations mostly affect the urban poor because conditions common in low socioeconomic areas tend to promote rodent breeding e.g. poor sanitation and drainage, open drains, uncollected solid waste, improper storage of food and overcrowding of homes (Resnik and Roman, 2007; Jones and Rainey, 2006; Landrigan et al., 1999). This is worrying as rodents are associated with many diseases such as Bubonic Plague, Leptospirosis, Lassa Fever, Salmonellosis, Rat-Bite Fever, Hemorrhagic Fever and Murine Typhus (Centers for Disease Control and Prevention CDC, 2010). These diseases can be transmitted through rodent bites, contamination of food with rodent urine or by rodents acting as vectors for other organisms such as fleas (CDC, 2010; Meerburg et al., 2010; De Faria et al., 2008; Tobin and Fall, 2004; Landrigan et al., 1999).

Often people rely on pesticides to manage an infestation as they are perceived to be the most effective method of control (Kirsten et al., 2006). In low socioeconomic communities, people commonly use 'illegal street pesticides' which are pesticides that are predominately meant for agricultural uses (Rother, 2010). These pesticides are cheap, easily available (as they are sold at accessible places such as taxi ranks), highly toxic and are not meant for domestic pest control (Rother, 2008). The use of these pesticides can result in severe acute effects (such as fatal poisoning) and chronic health effects (such as birth defects, cancers, asthma, reproductive complications and neurological defects) (Balme et al, 2010; Mir et al., 2010; Rother, 2010; Tolosana et al., 2009; Guilette, 2006; Kofman et al., 2006; Pogoda and Preston-Martin, 1997). The potentially high exposure of individuals to rodents and pesticides in urban, low socioeconomic communities is thus an important public health problem. In order to address the problems caused by rodents, non-toxic rodent control methods are needed in these communities.

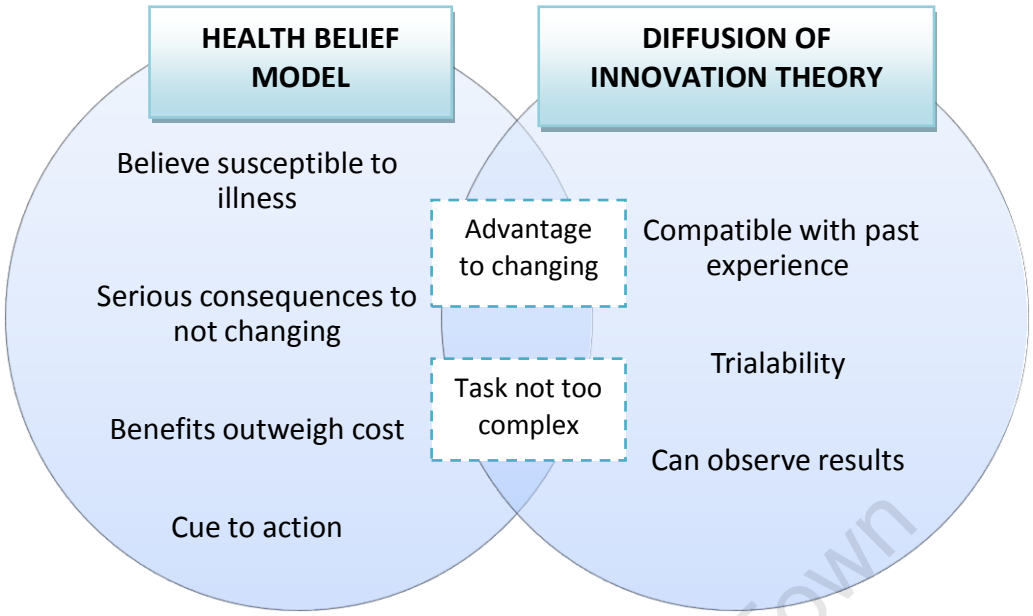
Alternative rodent control methods and behaviour change

Trapping is an alternative method that may reduce rodent infestations, as well as exposures to pesticides used for rodent control. The viability of an alternate method should be measured by its cultural acceptability and its ecological and socioeconomic sustainability (Aplin et al., 2003).

In the absence of studies on trapping interventions, rural studies were reviewed (Kirsten et al., 2006; Belmain et al., 2003). The use of non-toxic alternatives such as rat traps requires a shift in intentions, as people would have to switch from using illegal pesticides to a safer method of control. Health intervention research studies were reviewed to identify the relevant factors influencing successful intervention adoption and behaviour changes that would be applicable to a rat trap intervention (Scott et al., 2008; National Cancer Institute NCI, 2005; Palis et al., 2006). Two models of analysis were identified as useful for understanding trap adoption in lower socioeconomic communities – they are the Health Belief Model and Rogers' Diffusion of Innovation theory (Scott et al., 2008; NCI, 2005; Rogers, 1962; Figure 1). The Health Belief Model states that people are willing to change once they believe that they are susceptible to becoming ill (i.e. from pesticides), that there are serious consequences to not changing, that there are benefits to changing, that the benefits of taking action outweigh the cost, that they are prompted by some cue to take action and that they are confident that they can perform the activity without help (Rahman and Rahman, 2008; Simzekogulu and Lajunen, 2008; Palis et al., 2006; NCI, 2005). Rogers' Diffusion of Innovation theory identifies factors that affect adoption, namely, relative advantage, comparability, complexity, trialability and observability (Scott et al., 2008; Feder & Savastano, 2006; Chaves and Riley, 2001; Rogers, 1962). The two models are similar in that they both posit that if there is an advantage to changing to an intervention and if the intervention is not too complex, it is likely to be adopted. Thus these two factors may be more important to behaviour change than the other factors described as they are identified in both models. The similarities and differences between these models are summarized by Figure 1.

Gender also appears to be an important factor in the adoption of a rat trap intervention. A South African study surveying pest control methods used in homes found anecdotal evidence that males may prefer to use traps whereas females may prefer to use pesticides (HSRC, 2006). The study did not offer an explanation but a possible one is setting traps may be perceived as a male's responsibility.

Figure 1: Differences and similarities between behaviour change theories used



Assessing which factors affect behaviour change is important to the successful and efficient implementation of an intervention. In rural areas there is a financial incentive to use traps as rodents damage crops and contaminate the storage of produce, thus reducing profit. In urban areas rodents have a limited impact on economic livelihoods. Therefore justifying the benefit of monetarily investing in urban rodent control (despite the health risks that rodents and pesticides pose) may be a key barrier. However, factors such as the dislike of rodents (for consuming stored food), and the fear of rodents and rodent bites may also encourage people to adopt traps. There is a gap in the literature as trap intervention studies in urban areas have not been conducted and few studies have focused on reducing illegal pesticide use in poor urban communities. Thus this study aimed to make a contribution to the literature by investigating whether encouraging trap use by the urban poor works as a rodent control alternative. This paper presents factors identified which influenced respondents' behavioural intentions regarding rodent control.

METHODS

This dissertation forms part of a larger research project that investigated the link between illegal pesticides and child poisonings (Rother, 2010; 2008). A baseline survey was done and each household that participated received two rat traps (Figure 2). These rat traps are sturdier, heavier and have higher spring action compared to traps that are usually used in low socioeconomic communities. A follow-up survey assessed the use of the traps and levels of pesticides use. This paper presents the follow-up survey results.

Figure 2: Example of rat traps that were distributed to participants

Settings and subjects

The larger study identified the study sites (Philippi and Khayelitsha) as areas where high numbers of child poisoning due to street pesticides had occurred (Rother, 2010). Khayelitsha and Philippi are peri-urban areas of Cape Town comprised of formal and informal housing. Khayelistsha Site C (sample site) was sampled and has an estimated population of 23 358 (City of Cape Town CCT, 2006). Philippi East (sample site) had an estimated population of 28 812 (South African Environmental Program, 2007; CCT, 2006). Both areas have poor sanitation, infrequent refuse removal and overcrowded conditions (Rother, 2010).

Figure 3: Cape Town with Philippi and Khayelitsha

Source: City of Cape Town (2006) Housing Projects

Data Collection:

Baseline survey

Systematic random sampling involved interviewing every tenth house starting from the local community centre in each area. By May 2009, 199 language-appropriate, face to face interviews were conducted by trained community fieldworkers in Philippi (n=100) and Khayelitsha (n=99). Each household participating in the baseline survey received two rat traps (Figure 2).

Follow-up survey

The same fieldworkers from the baseline survey were employed six months later to administer the follow-up survey. The fieldworkers were trained for two days by the Principle Investigator. The questionnaire was piloted with two households from the baseline study which were subsequently excluded from the follow-up study. The fieldworkers were given the addresses to locate the homes of the original participants and 175 were successfully located. It was not required that the same participants be followed up, only that the same household was interviewed. Table 1 summarises the questions analyzed for this paper (the survey can be found in Appendix Part D).

Table 1: Survey questions used

Data	No.	Question in Survey	Variable Name
Outcome	1	Will you continue using traps for controlling rats or mice? Yes or no?	Intended trap use
	2	Will you continue to use pesticides (poison / medicine / chemicals) bought at shops or taxi ranks to kill rats and mice?	Intended pesticide use
Predictor Variables	3	Have you used the University of Cape Town rat traps since they were given to you?	Used traps
	4	Did the traps catch any rats or mice?	Trap caught rodent
	5	What were you using to kill rats or mice before you got these rat traps?	Pesticides used for rats before given traps
	6	Are you still using pesticides to kill rats or mice?	Current pesticide use
	7	Which is more expensive buying a rat trap or pesticides per month?	Find traps more expensive than pesticides
	8	Are rats and mice still a problem in your house?	Current rodent infestation
	9	Would you buy a rat trap from a taxi rank or street market?	Would buy trap from taxi rank
	10	Did you have problems or difficulties using the traps?	Problems with traps
Qualitative Data	11	Will you continue using traps for controlling rats or mice? If no, why not?	
	12	Did you have problems or difficulties using the traps? Explain if yes.	
	13	What did you like about the traps?	

Data analysis

The data were entered into EpiData (version 3.1) and cleaned. For qualitative responses a codebook was developed and responses were separated into themes. These were then categorised and converted into categorical data.. Data exploration took place through cross-tabulations, boxplots and Chi square tests (Fischers exact tests were used if the stratified samples were too small) in the survey suite of STATA.

The variable originally chosen as the outcome of interest ("*intended trap use*") had a high "yes" proportion which can cause problems with the data because the response was not varied enough. Therefore, a second, complementary outcome was chosen ("*intended pesticide use*"). These outcomes were assessed separately and were not mutually exclusive as some respondents may have intended to use both traps and pesticides. The independent variables indentified are listed in Table 2.

Table 2: Dependent and independent variables

Data	Variable
Dependent Variables	1) Intended trap use
	2) Intended pesticide use
Independent Variables	3) Used traps
	4) Trap caught rodent
	5) Pesticides used for rats before given traps
	6) Current pesticide use
	7) Find traps more expensive than pesticides
	8) Current rodent infestation
	9) Would buy trap from taxi rank
	10) Had problems with traps
	11) Age
	12) Gender

To assess factors related to rodent control intention, several models were built using manual model building and stepwise techniques. For model building, missing data were dropped and Akaike Information Criterion (AIC) statistics and Likelihood Ratio Chi square tests were used to determine whether variables significantly contributed to the model. The manual model building process was executed in standard STATA as the survey suite does not allow for AIC statistics. The model was then tested in the survey suite. Two logistic regression analyses were then performed using "*intended trap use*" and "*intended pesticide use*". "*Age*" was the only continuous variable used and thus does not appear in some of the tables. All analyses were conducted using STATA (STATA for Windows, version 10, Stata Corp; College Station, TX).

Ethical considerations

The study was granted ethics approval by the University of Cape Town Human Research Ethics Committee (REC REF: 375/2005 in Part D). All participants signed a consent form prior to participating.

RESULTS

Follow-up rate

Of the 199 respondents from the baseline survey, 88% (N=175) were followed up. Khayelitsha had a slightly higher loss to follow up (i.e. of the 99 participants, 13 were not followed up).

Data exploration: Overall results

Demographic data

The median age of the sample was 31 years (range: 25 - 41 years). Slightly more of the respondents were female (53.8%, n=93). The median schooling grade attained was Grade 11 (range: Grade 8 - Grade 12). Monthly income levels were low - with the median category being R1000-R1999 (range: R500-R999 - R2000-R2999) (exchange rate: R1.00 = US$0.14).

Survey results

Table 3 shows that 85% (n=147) of participants indicated that they intended to use traps, 30% (n=47) indicated that they intended to use pesticides and 22% (n=35) indicated that they intended to use both. Most people used the traps (88.0%, n=154) and most of the traps caught rodents (85.0%, n=148). Quite a number of people still had a problem with rodent infestations (44.4%, n=76).

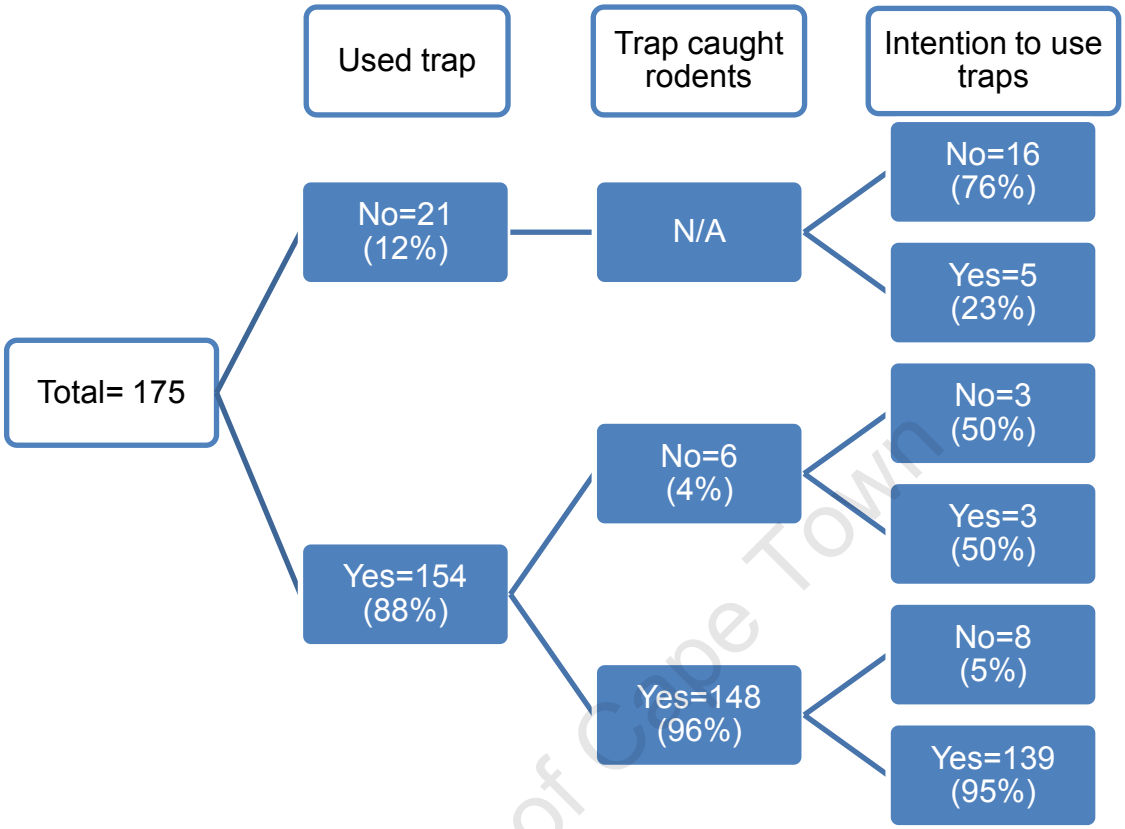
Table 3: Univariate results

Data	Variable	Total No. (n)	Yes (%)
Outcome Variables	1) Intended trap use	174	84.5
	2) Intended pesticide use	161	29.2
Predictor Variables	3) Used traps	175	88.0
	4) Trap caught rodent	174	85.1
	5) Pesticides used for rats before given traps	175	78.3
	6) Current pesticide use	171	34.5
	7) Find traps more expensive than pesticides	167	62.9
	8) Current rodent infestation	171	44.4
	9) Would buy trap from taxi rank	173	79.2
	10) Had problems with traps	174	10.9

Pathway of uptake of traps

Most people used the traps (88.0%, n=154) and most of those had traps that caught rodents (96.1%, n=148). This translated to a large number of people that intended to use traps in future. Overall, even those that did not use traps were still willing to use them in future. Interestingly, there were eight people who said they would not use traps in the future despite using the traps and successfully catching rats with them. The variables "*used trap*" and "*trap caught rodents*" were highly collinear.

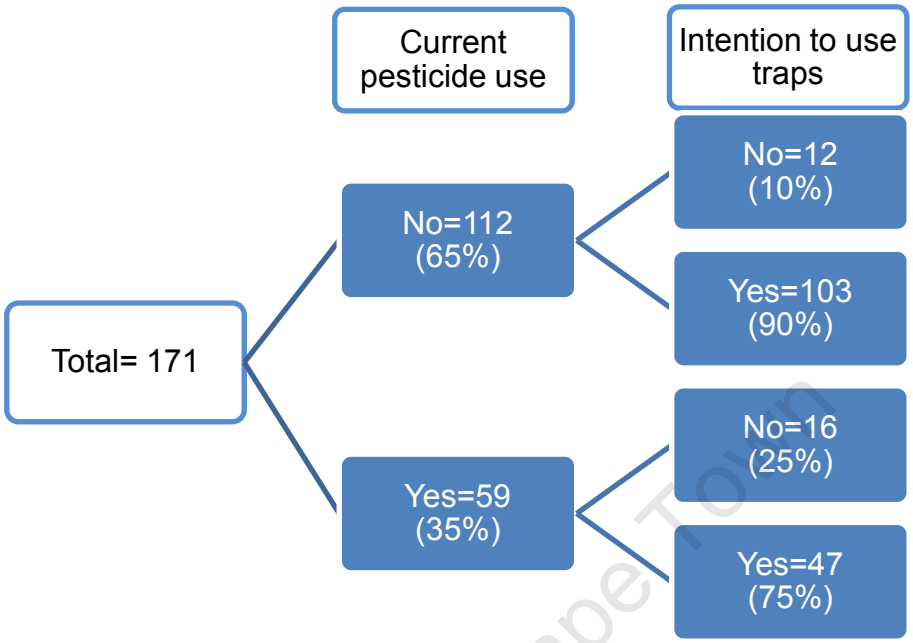
Figure 4: Uptake of traps*



note that totals may not add up owing to missing data

Sixty-five percent (n=112) of the 171 respondents were not currently using pesticides (Fig 5). Of those that were not using pesticides, 89% (n=103) said they intended to use traps. Of those that were currently using pesticides, 75% (n=47) said they intended to use traps.

Figure 5: Current pesticide use and intention to use traps*



note that totals may not add up owing to missing data

Stratified analysis of data by rodent control intentions

The variables: whether *traps were used* [POR: 41.30 (CI: 12.73-133.99)]; whether *traps caught rodents* [POR: 39.09 (13.06-116.98)]; *current pesticide use* [POR: 0.32 (0.14-0.75)] and whether people *would buy traps from taxi ranks* [POR: 30.56 (10.66-87.60)] were all significantly associated with the intention to use traps. More males (91.1%) compared to females (79.6%) intended to use traps in future but the difference was not significant.

Table 4: Variables stratified by intentions of rodent control use

Data			Intended trap use		Intended pesticide use	
	Variables	Response[i]	Intended trap use (%)	Prevalence Odds ratio (95% CI)	Intended pesticide use (%)	Prevalence Odds ratio (95% CI)
Outcome	Intended pesticide use	Yes	74.5	**0.3 (0.1-0.8)**	–	–
		No	89.3			
Demographic	Gender	Male	91.1	2.6 (1.0-6.6)	26.0	0.8 (0.4-1.5)
		Female	79.6		32.1	
Trap related	Used traps	Yes	92.7	**41.3 (12.7-133.9)**	25.9	**0.3 (0.1-0.7)**
		No	23.8		55.0	
	Trap caught rodent	Yes	94.5	**39.0 (13.0-116.9)**	24.6	**0.3 (0.1-0.7)**
		No	30.8		54.1	
	Problems with trap	Yes	57.9	**0.2 (0.1-0.5)**	61.1	**4.6 (1.7-12.8)**
		No	88.2		25.7	
	Would buy trap from taxi rank	Yes	95.6	**30.6 (10.6-87.6)**	25.8	**0.4 (0.2-0.9)**
		No	41.7		44.1	
Pesticide related	Pesticides used before traps given	Yes	87.8	1.8 (0.8-4.5)	36.1	**collinear**
		No	72.9		0.0	
	Current pesticide use	Yes	74.5	**0.3 (0.1-0.8)**	75.0	**58.2 (19.6-171.9)**
		No	89.9		5.0	
	Traps more expensive than pesticides	Yes	77.0	0.4 (0.2-1.0)	32.7	1.2 (0.6-2.6)
		No	88.5		27.7	
Rodent related	Current rodent infestation	Yes	81.6	0.7 (0.3-1.6)	38.2	2.0 (1.0-4.0)
		No	86.2		23.6	

i Data tabulated into row percentages

Adjusted analysis: Factors influencing trap adoption

Forward stepwise regression was used to obtain the predictive model with the best statistical fit. Several variables appeared to be important to both models and these are:

- *Traps caught rodents:* This variable was a significant and strong predictor of intent to use traps in the future (Table 5). Participants that had a trap that caught rodents had 14.6 (95% CI: 3.49-61.43) times the odds of intending to use traps, compared to participants whose traps did not catch rodents.

- *Would buy trap from a taxi rank*: The willingness to buy a trap from a taxi rank (where street pesticides are sold) was strongly and significantly indicative of the intention to use traps (Table 5). Participants who were willing to buy traps from a taxi rank had 14.8 (95% CI: 3.32-37.50) times the odds of intending to use pesticides, compared to participants who were not willing to buy traps from a taxi rank.

Table 5: Trap use intent models (adjusted Prevalence Odds Ratios and 95% Confidence Intervals)

Variable	Model 1 (Full Model)	Model 2 (Stepwise Model)
Traps caught rodents	**16.02 (3.14-81.62)**	**14.64 (3.49-61.43)**
Current pesticide use	0.77 (0.16-3.57)	-
Traps more expensive	0.86 (0.18-4.03)	-
Current rodent infestation	0.88 (0.16-4.62)	-
Would buy trap from taxi rank	**11.17 (2.34-53.32)**	**14.78 (3.32-37.50)**
Gender (Male)	**6.23 (1.04-37.09)**	**7.02 (1.31-37.50)**
Problems with traps	0.39 (0.05-2.80)	-
Age	0.98 (0.92-1.04)	-

- *Gender:* Males had 7.02 (95% CI: 1.31-37.50) times the odds of intending to use traps, compared to females (Table 5). This relationship was robust although the lower confidence limit was close to the null.

- *Current pesticide use*: Current pesticide use was strongly associated with the intention to use pesticides (Table 6). Participants who were using pesticides at the time of the study had 83.6 (95% CI24.67 - 283.26) times the odds of intending to use pesticides in the future, compared to participants who were not using pesticides at the time of the study.

Table 6: Pesticide use intent models (adjusted Prevalence Odds Ratios and 95% Confidence Intervals)

Variable	Model 1 (Full model)	Model 2 (Stepwise Model)
Trap caught rodents	0.33 (0.04-2.49)	-
Current pesticide use	**84.08 (22.07-319.70)**	**83.60 (24.67 - 283.26)**
Traps more expensive	0.96 (0.25-3.61)	-
Current rodent infestation	0.73 (0.19-2.78)	-
Would buy trap from taxi rank	1.91 (0.33-11.31)	-
Gender (Male)	0.81 (0.22-2.85)	-
Problems with traps	4.50 (0.52-39.19)	-
Age	0.99 (0.95-1.04)	-

Qualitative data analysis

Use of and problem with traps

Of the 22 people who answered they would not use traps, 32% (n=7) said they were scared of the trap or did not know how to use it; 32% (n=7) said the traps were too slow (i.e. caught rodents one at a time) and did not catch rats; 23% (n=5) said they would not use them as they no longer had a problem with rodents; and 14% (n=3) gave other reasons (e.g. they have pesticides or they gave the trap away).

Only 18 participants indicated that they had a problem when using the traps and most concerns were from females (77.8%,n=14). Half of the participants (n=9) said that they were scared to use the trap or scared that their children might get hurt by them. All nine (50.0%) people who felt scared of the trap were female respondents. Some of these participants indicated that they did not know how to use the traps (22.2%, n=4). One respondent said that "at first everyone was scared of it until our big brother came and did it for us. Now all of us are using it". Two indicated that the trap caught rodents too slowly (i.e. one at a time) and two indicated that they had mechanical problems with it (i.e. one person said "sometimes the bigger rats will move the traps and you find it somewhere else. Traps need more weight").

Likes about the traps

Of the total sample, 85% (n=148) of participants indicated that they liked the traps. Most participants (33.1%, n=49) liked the fact that the traps worked efficiently, 18% (n=26) that the traps were safer than pesticides and 18% (n=25) that the rodent carcass was easy to find as it dies in the trap. Furthermore, 14% (n=21) liked the power and look of the trap whilst 10% (n=15) liked the fact that there were fewer rats and 8% (n=12) that they were easy to use. One respondent said that they appreciated "[the] satisfaction of seeing the rats dying and there is no danger to our dogs as they would sometimes eat the poisoned rats". Of all the categories, the fact that the traps worked well was by far the most popular response amongst males (40.8%, n=29). The most popular response amongst females meanwhile was the fact that there was no odour caused by using traps as the rodent carcass was easy to locate (26.7%, n=20).

DISCUSSION

Appropriateness of the intervention

One aim of this research was to determine if rat traps could be an appropriate rodent control alternative to pesticides, in low socioeconomic communities in South Africa. Aplin et al. (2003) stated that the viability of an alternate rodent control should be measured by its cultural acceptability, and its ecological and socioeconomic sustainability.

The intervention appeared to be culturally accepted as participant use was high (88.0%, n154), most of the participants liked the traps (83.4%) and few participants had problems with the traps (10.9%, n=19). In comparison to pesticides, rat traps are also more ecologically sustainable as they do not contaminate the environment (e.g. soil and air) as pesticides do so either directly or indirectly (e.g. through a poisoned rat). Pesticide use appeared to decrease between the baseline and follow-up survey. Before the intervention, approximately four fifths of participants indicated that they used pesticides (78.3%, n=137) whereas at the time of the follow-up survey, under two fifths (34.5%, n=59) of participants were using pesticides. Even though 63% (n=105) of participants viewed purchasing rat traps as being more expensive than pesticides, a high proportion of the sample were willing to buy traps from taxi ranks (78.9%, n=137). This showed that participants were willing to buy traps at accessible locations and also that the trap was valued because it worked well

Compatibility with Behaviour Change Theories

The majority of participants intended to use the traps which showed that there was a general willingness for people to change their preferred method of rodent control. This study aimed to identify factors influencing trap adoption in order to inform future interventions. For this purpose, two theories (Figure 1) were hypothesized to predict the uptake of an intervention – the Health Belief Model and the Diffusion of Innovation Theory (NCI, 2005; Rogers, 1962). This study confirmed many of the factors that these theories predicted would be important to the uptake of an intervention and these are discussed below.

Overlap between behaviour change theories

Both the Diffusion of Innovation Theory and the Health Belief Model identified that having an advantage to using an intervention was associated with its adoption (Scott et al., 2008; NCI, 2005). This fits with the qualitative findings of this study as there were several advantages identified by participants to using the traps. Many participants found that being able to easily locate the rodent carcass after being caught in a trap as an important advantage. This is because when rodents consume pesticides, they do not die instantly and can run into inaccessible hiding places before eventually expiring. The resultant odour of decaying rodent carcasses in inaccessible places is a noted drawback of pesticide use and could be marketed as a reason to use rat traps instead of pesticides.

Both behaviour change theories also predicted that the adoption of an intervention would occur when the intervention was easy to use. This holds true for this research and the HSRC (2006) study as females were less likely to use traps, possibly as they found traps more complex to use. It appeared that more females had problems using the traps, many admitting that they were scared to use them as they could hurt them or their children. Males appeared more likely to use the traps. This may be due to societal roles placed upon them as males will often be looked upon as protectors and may see it as their duty to eradicate larger pests. Since traps require some physical strength to set, this may enforce the perception that it is a male's responsibility to do so. Females may quite simply view pesticides as easier to use as it requires little physical effort to apply.

Health Belief Model

According to the Health Belief Model (NCI, 2005), believing that you are susceptible to an illness and recognising that there are serious consequences to not changing your current behaviour, would make you more likely to adopt an intervention. From the qualitative data findings, there appeared to be awareness that pesticides were harmful, even though participants were not asked this question explicitly and 23% (n=32) of people said they would not use pesticides because of this reason. This showed that people felt susceptible to the health effects of pesticides and this motivated them to change their behaviour. The Health Belief Model also states that if participants feel that the benefits of the intervention outweigh the cost, they would be more likely to change (NCI, 2005). The willingness to buy traps at a taxi rank where pesticides are usually sold was a strong predictor of trap adoption. The variable was treated as a possible confounder because it could be a proxy for the outcome but it was found to not be one. Many people indicated that they were willing to buy traps. However, when asked what they were willing to pay for traps, many quoted prices that

were much lower than what the traps actually cost but more expensive than the current prices for street pesticides.

Illegal pesticides are cheap (R1-R2; Rother, 2010) and traps represent an investment because they are more expensive but can last longer (people need to continually purchase pesticides). The cost-benefits of investing in a trap may need to be marketed as a way to promote trap use. Traps could compete with pesticides if the price of traps were subsidized by government or another organisation (e.g. industry, NGOs). Alternatively, a system whereby the traps could be bought in instalments could be arranged. This would ensure that the prices of pesticides are matched (the monthly payments offset by the fact that the same amounts would have been spent replenishing pesticides). These findings show that alternatives are viable and people are willing to use them if they are made available in their communities.

Diffusion of Innovation Theory

The Diffusion of Innovation Theory predicted that having an intervention in line with past experience may aid in the adoption of an intervention (Rogers, 1962). Having past experience with traps, however, was not associated with the intention to use traps (Table 5). One explanation may be that those who had past experience with traps used the types commonly sold in South African supermarkets. These traps are made of flimsier material (wood) and are not as efficient as the heavy duty steel traps distributed during the intervention. Thus participants may have already formed the perception that the traps do not work due to experience with an inferior product. The theory also dictates that trap adoption would occur if people have a trial period to test the technology (Scott et al., 2008). This occurred in the study through participants getting traps for free. In addition, the theory predicted that having observable results would help in the adoption of an intervention (Scott et al., 2008). Whether the trap caught rodents or not was highly predictive of trap adoption as the traps were effective (only a minority of participants did not catch rodents with their trap.) The fact that very few participants did not catch rodents using the rat traps indicate fairly high levels of pest infestations and also that the traps were effective in combating them. This proves that participants are willing to use an intervention if there is evidence that the intervention works.

As neither of the two behaviour change theories is specific to rodent control, they do not take the size of a pest infestation into account. However, current levels of pest infestation had no association with whether participants used the traps or would use them in the future. This

may indicate one of the limitations of the study as data were self-reported and thus different people may have different perceptions as to what they determine an “infestation” to be.

Limitations

The study had several limitations, namely:

Survey design

As with all surveys, it is not possible to establish temporality and thus it is difficult to interpret results as being caused by the intervention. For example, it is difficult to ascertain whether people stopped using pesticides because they no longer had a problem with pests or if the traps had a definite impact on their perception of pesticides.

Also, between the household survey and the follow-up survey, the same person was not necessarily interviewed (only the same household was represented). Thus the baseline survey cannot accurately be compared to the follow-up survey. However, since data for this analysis were only used from the follow-up survey, this may not be a significant limitation. A number of people in Khayelitsha were loss to follow up because some relocation of informal dwellings occurred at the time the follow-up survey was conducted. Despite this, 88% (N=175) of households were followed up.

Sample Size and Power

Another limitation was that the study had a small sample size and therefore did not have enough statistical power for many of the results to emerge as significant and yield narrow confidence intervals. The small sample size also led to statistical collinearity between a number of variables. Furthermore, there was no control group to compare the intervention users against which restrict the study’s validity.

Self-report data

The data were self-reported and thus could suffer from a desirability bias. Participants may have answered in a way in which they thought the interviewer would prefer. Fieldworkers were trained to minimize this behaviour and ensure that they did not prompt participants for answers. In addition, there is no objective measure of whether traps were used and whether they decreased infestations or pesticide use. Future interventions could take objective measures of pesticide residues to show whether pesticide use had decreased and use methods to determine whether the prevalence of rodents decreased.

CONCLUSION

With expected increases in pest infestations and pesticide use in urban areas (Gratz et al., 1999), it is important to encourage the use of alternative rodent control methods. Participants are desperate to alleviate their rodent infestations and are thus willing to use pesticides even when they know it is dangerous to their health. The sustained use of rat traps in low socioeconomic communities could help to decrease the double health burden caused by the exposure to pesticides and rodents. Despite this study's limitations, rat traps were shown to be a viable alternative as participants used the traps to catch rodents and decreased their pesticide use. There may be a few options for promoting the sustained use of traps - one would be to increase the availability of traps by encouraging informal vendors selling street pesticides to sell traps or to have people in these communities make cheap and effective traps. It may be possible for government, NGOs or even business entrepreneurs to subsidize or source cheaper traps of the same quality (through importing or through investing in businesses to manufacture traps)

An interesting finding was that there was a gendered approach to rodent management. This shows that in future interventions, effort should be put into making sure that females are given extra support when shown how to set traps. Males could be involved in future interventions or initiatives, as drivers of trapping programs in communities. The data also provided insight into some of the problems experienced with the traps (e.g. catching rodents one at a time, too difficult to use, too light). Some of these obstacles could be addressed by making heavier traps or using multiple traps to catch rodents faster. There is also a need to emphasize how one can make traps safer to use if there are children in the home e.g. such as only putting them out at night when children are asleep. Additional education also needs to go into publicising the ill effects of using illegal pesticides as this knowledge does appear to affect rodent management strategies to a certain extent.

This study demonstrated that there is a willingness to use traps for rodent control in impoverished urban communities and that it could be a viable alternative to street pesticides. Further studies could help to determine if sustained trapping in urban communities reduces rodent populations and causes a reduction in pesticide use. If so, there is a need to advocate for the accessibility of rat traps in these impoverished, urban communities.

ACKNOWLEDGEMENT:

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Part D: Appendices

1. QUESTIONNAIRE: FOLLOW-UP SURVEY

Follow-up Use of Rat Traps Questionnaire – 2009

Respondent Number: ☐☐☐ **Date:** ☐☐☐

Interviewer's initials: _____

Location: _____ **Address:** _____

1. **Date of Birth**:_____(Age_____)
2. **Gender:** ☐ **Female** ☐ **Male**
3. Went to school? Yes_____ No_____
4. Highest standard/grade passed at school:_____
5. How many rat traps have you used on your property since May this year?

0___ 1___ 2___ 3___ 4___ 5___ more than 5___

5a) How many were given to you from UCT? _____

5b) Have you bought any rat-traps since May? If yes how many? _____

6) Have you used the UCT rat traps since they were given to you? ☐ Yes ☐ No

7) Did the traps catch any rats or mice? ☐ Yes ☐ No

If yes, how many?

	Rats caught per week Picture A	Rats caught per week Picture B	Mice caught per week Picture C
None			
Seldom			
One a week			
2-3 a week			
5-10 a week			
Too many to count			

8) What were you using to kill rats or mice before you got these rat traps? (tick)

Pesticides_____ Nothing_____ Other_____

If you were using a pesticide was it one of these? [can tick more than one]

Product used from Pink Point Chart	5
1	6
2	7
3	8
4	9

Other: _____

9) Are you still using pesticides to kill rats or mice? ☐ Yes ☐ No

9a) If yes, indicate which pesticides by using the point chart: [can tick more than one]

Product used from Pink Point Chart	5
1	6
2	7
3	8
4	9

10) Which is better at killing rats and mice? ____ pesticides ____ rat traps

*[If in question **10**, the respondent says rat trap are better, whereas in **6** she said she never used the rat traps that were give to her, ask her how she knows that rat traps are better at killing rats and mice]*

_____
_____

11) Please explain why?

_____

_____

12) Did you have problems or difficulties using the traps? ☐ Yes ☐ No

If yes, Explain:

_____
_____
_____

13) What did you like about the traps?

_____
_____

14) What did you not like about the traps?

_____
_____

15) Will you continue using traps for controlling rats or mice? Yes ☐ No ☐

15a) If no, why not?

_____
_____

16) Will you continue to use pesticides (poison / medicine / chemicals) bought at shops or taxi ranks to kill rats and mice? Explain why or why not?

_____

_____

17) How much would you pay for a rat-trap?

_____

18) Which is more expensive, rat traps or pesticides? rat-traps_____ pesticides_____

19) Describe how you used your trap (explain step by step and in detail) and then what you do after a rat/mouse has been caught in it.

_____
_____

20) Are rats and mice still a problem in your house?

_____
_____

21) Why do you think you have a problem with pests (e.g., rats, cockroaches, flies) in your home?

_____
_____

22) Would you buy a rat trap from a taxi rank or street market? ☐ Yes ☐ No

_____
_____

23) Do you have any other comments or suggestions you would like to make regarding using pesticides and rat traps?

_____

24) What is your monthly household income?

Monthly Household Income	Please tick
R0 - 499	
R500 - 999	
R1000 - 1999	
R2000 - 2999	
R3000 - 3999	
R4000 - 4999	
R5000-5999	
R6000 or more	

25) How much do you spend a month on pesticides?

Monthly Spend on Pesticides	How much do you spend per month on all kinds of pesticides for Cockroaches, ants, flies etc. Please Tick	Since May how much have you spent /month on pesticides to kill rats and/or mice. Please tick
R0		
R1-R5		
R6-R9		
R10-R29		
R30-R49		
R50-R69		
R70-R99		
R100 - R149		
R150 -R199		
R200 or more		

Thank you for taking the time to answer these questions

2. CONSENT FORM

RAT TRAP USE QUESTIONNAIRE CONSENT - 2005

Read to respondent:

Hello, my name is …… I am from the University of Cape Town. Two months ago we came to ask you questions about the use of pesticides on this property. At the end of the questioning, we left you with some rat traps.

I would like to ask your permission to ask you questions about your use of these traps and what you think about them.

Your participation in this study is very important to us and will assist us in understanding better about pesticide alternatives to controlling rats. Your answers will help us to know what issues and problems are involved with using rat traps.

This interview is confidential; that is none the information you give will be connected to you personally. I will not write your name down. Only the researchers will see your answers. Your participation is voluntary, which means that you can refuse to participate and you can stop the interview at any time.

This is not a test and there are no right and wrong answers. Please try to answer these questions as truthfully as possible for us to better understand the use of rat traps. If you do not understand a question, please ask me to repeat it or explain it. The interview should take 10-15 minutes.

This study will not involve any harm or discomfort to you. May I interview you? May I start the interview now? (**If yes, please sign below.)**

If you have any questions or want further information about the study, please contact:

Study Principle Investigator:

Dr. Andrea Rother

School of Public Health and Primary Health Care, University of Cape Town,
Anzio Rd., Observatory 7925, South Africa, T: (021) 4066300; F: (021) 4066163; e-mail: andrea@cormack.uct.ac.za

_____	_____	
Printed name of participant	**signature**	**Date**
_____	_____	
Interviewers (print)	**signature**	**Date**
_____	_____	
Witness (print)	**signature**	**Date**

3. LETTER OF APPROVAL FROM RESEARCH ETHICS COMMITTEE

UNIVERSITY OF CAPE TOWN

Health Sciences Faculty
Research Ethics Committee
Room E52-24 Groote Schuur Hospital Old Main Building
Observatory 7925
Telephone [021] 406 6338 • **Facsimile** [021] 406 6411
e-mail: preaward@curie.uct..ac.za

07 May 2007

REC REF: 222/2007

Dr A Rother
Public Health & Family Medicine

Dear Dr Rother

PROJECT TITLE: CONSEQUENCES OF THE USE OF "STREET PESTICIDES"AND COMMERCIAL PESTICIDES FPR PEST CONTROL IN SOUTH AFRICA'S PERI-URBAN AREAS ON CHILDREN'S HEALTH AND HEALTH POLICY

Thank you for submitting your study to the Research Ethics Committee for review.

It is a pleasure to inform you that the Ethics Committee has **formally approved** the above-mentioned study.

As we discussed on the telephone, please could you let us have copies of new informed consent forms and questionnaires or information regarding other study methods which you intend using as the research develops.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please quote the REC. REF in all your correspondence.

Yours sincerely

A/PROF. M. BLOCKMAN
CHAIRPERSON, HSF HUMAN ETHICS

lemjedi

UNIVERSITY OF CAPE TOWN

Health Sciences Faculty
Research Ethics Committee
Room E53-24 Groote Schuur Hospital Old Main Building
Observatory 7925
Telephone [021] 406 6338 • **Facsimile** [021] 406 6411
e-mail: preaward@curie.uct..ac.za

17 October 2005

REC REF: 375/2005

Dr HA Rother
Public Health and Family Medicine

Dear Dr Rother

CONSEQUENCES OF THE USE OF 'STREET PESTICIDES' TO CONTROL RATS IN SOUTH AFRICA'S PERI-URBAN AREAS FOR CHILDREN'S HEALTH AND HEALTH POLICY

Thank you for submitting your study to the Research Ethics Committee for review.

Date Considered: 10 October 2005

Decision: Approved

It is a pleasure to inform you that the Ethics Committee has formally approved the above-mentioned study.

Please quote the REC. REF in all your correspondence.

Yours sincerely

PROF T. ZABOW
CHAIRPERSON

KBonani

4. INSTRUCTIONS FOR AUTHOR (Journal of Environmental Health Research)

Source: http://www.cieh.org/jehr/contributors.html

Invitation to contributors

Contributions are invited on any of the diverse aspects of environmental health including occupational health and safety, environmental protection, health promotion, housing and health, noise and health, public health and epidemiology, environmental health education, food safety, environmental health management and policy, environmental health law and practice, sustainability and methodological issues arising from the design and conduct of studies.

Contributions should have the potential to improve practice through the dissemination of the results of research projects, reviews based on scholarly reflection and technical notes and professional evaluations which provide critical insights into practice issues. It is likely that most papers published will be based on work carried out as part of a research project or programme associated with an academic or other research institution. Contributions are expected to be of a high standard, not only in respect of subject matter and its treatment, but also in the quality of the writing. Particular attention should be paid to clarity and conciseness of expression.

Originality

Only original articles are considered for publication. Submission of a manuscript represents certification on the part of the author(s) that the article submitted has not been published, nor is being considered for publication, in another similar journal. Contributions may, however, be based on a prior conference presentation. A statement confirming originality should accompany the manuscript.

Peer review

All contributions which are considered by the Editors to be within the aims and scope of the Journal are subjected to peer review by at least two reviewers. It is likely that one reviewer will have an academic research background and the other a practitioner or management background. Decisions on publication are made by the editors who are informed by the comments of the reviewers and the responses from the author(s) to the peer review reports.

Style

These notes are intended to guide authors in some details of presentation so that papers conform to a consistent Journal style. Authors must comply with the style requirements in every respect. For example, manuscripts which are too long, have too many headings or tables or references which do not fully conform to the Harvard protocol will be returned to the author(s). Thus authors are encouraged to study these notes and those on-line carefully whilst preparing their manuscript.

Length

Research papers; 3,500 to 6,000 words.

Professional evaluations and literature reviews: up to 6000 words, but preferably shorter. Technical notes, not normally more than 2000 words. Workshop/Conference Reports; up to 2000 words.

Tables, charts and photographs

These should be kept to a minimum consistent with the concise nature of the papers published in this Journal.

Language

Manuscripts are accepted in English only.

Layout/sequencing

The manuscript should normally be sequenced as follows: Title; Author(s); Abstract (300 words +/- 10%); Key words (up to 8); Introduction; main exposition (typically this section consists of the Methods and Results); Discussion; Conclusions; Acknowledgements; References.

Further essential details on each of these is available here on the website and in:

- **Harvey H D and Fleming P** (2007). Writing for JEHR – an update and reminder for prospective authors. *Journal of Environmental Health Research*, 6 (1), pp 49-55.

Electronic submission

The submission of manuscripts will normally be by Email and word processed file attachment only, with no requirement for the submission of printed copies. The word processed document should conform to the following specification to facilitate the peer review process and editing;

- MsWord (.doc) is the preferred word processor format but WordPerfect (.wpd) and Rich Text Format (.rtf) are acceptable.
- Times New Roman, 12 point, Single spacing.
- Do not indent paragraphs, do not number the pages nor insert headers or footers.
- The Cover Page should give the title of the paper, the name(s) and affiliations of the authors plus an Email address, telephone number and postal address for the corresponding author. Add a page break at this point and go on to the First Page.
- The First Page should repeat the Title only (not the author's details) plus the Abstract, Key Words and continue into the Introduction and the remainder of the manuscript.
- All tables, charts and photographs should be included as part of the manuscript file, unless there is pressing technical reason for having separate graphics files.
- The file should be named with the name of the first author e.g. Wilson.doc.
- Email to m.vaganay@ulster.ac.uk

Excerpts from: Harvey H D and Fleming P (2007). Writing for JEHR – an update and reminder for prospective authors. *Journal of Environmental Health Research*, 6 (1), pp 49-55, http://www.cieh.org/JEHR/writing_for_the_jehr.html [accessed 6/9/2010]

Instructions for authors:

The title

The names should be formatted exactly as instructed by the journal. Sometimes this will include post nominal letters (letters after your name), sometimes not. Mostly, authors' affiliations will be included (i.e. employer or organisation) and one author must be identified as the 'corresponding author' whose contact details will be published. For JEHR the style is:

The social construction of hygiene in the home: information, attitudes, behaviour and the consumer

Dr Lucy Meredith1, Dr Mary Haslum2, Roger Lewis3 1 Faculty of Applied Sciences, University of the West of England 2 Reader in Psychology, Faculty of Applied Sciences, University of the West of England 3 Visiting Researcher in Medical Microbiology, Faculty of Applied Sciences, University of the West of England Correspondence: Dr Lucy Meredith, Faculty of Applied Sciences, University of the West of England, Coldharbour Lane, Frenchay, Bristol. BS161QY. Telephone 0117 965 6261 ext 82519. E-mail: lucy5meredith@uwe.ac.uk

The introduction

Experts suggest that you have about 30 seconds worth of readers' time in the introduction to confirm to them that they should continue to read your paper. The introduction should therefore be fairly concise, but its length will vary depending on the subject and the overall length of the paper. It should be well referenced in accordance with the protocol followed by the target journal (see later).

The introduction typically outlines the topic, explains to the reader why you were interested in the subject, summarises the relevant literature by means of a literature review and states how your work, which you are just about to describe, contributes to the subject. The literature review should identify the key contributions of past researchers, and identify theories or patterns or schools of thought/key debates. You could end the introduction by suggesting that the current research is needed to answer some outstanding question and/or a concise paragraph that explains the aims of your paper.

Results

Obviously this is where you present your findings, but you need to think carefully about how you will present them within the constraints of a paper for publication; what would be suitable in a 20,000 word dissertation will almost certainly be beyond the scope of the average academic paper. Use tables and graphs if appropriate but it is a good idea to also summarise your main findings in the text. Many journals (including JEHR) request a minimal use of tables and graphs or suggest a maximum number allowable. If you do use tables or graphs, make sure that you include an explanatory title. If you can summarise the information in a sentence, then a table or graph is not necessary.

The results section is not the place to discuss the data; that comes in the formal discussion unless you have opted for a combined results/discussion section, which may be appropriate in some papers. It is, however, the place to record data that may prove that you 'failed' to prove your hypothesis (or 'hunch' in qualitative work). Remember, recording and discussing the research that 'didn't work' is as important as recording that which did. If you have conducted your research rigorously, then results differing from what you expected are as interesting and valid to report. You could prevent the wastage of many person-hours and considerable sums of research funds by warning others of pitfalls and unsuccessful designs.

The conclusions

The characteristics of a good 'conclusions' section are simplicity, logic, ease of understanding and inclusiveness; not easy to achieve in a few words! Yet the conclusions and the abstract may be the only parts of the paper that some people read. It would be appropriate to include a brief summary of the paper's main points, including the clear answers that you have been able to come to as a result of your work. Don't be afraid to say if questions remain unanswered as it may be appropriate to suggest some further research work to provide further answers. You may also wish to ask a provocative question and/or call for some sort of action. In JEHR we commonly 'bullet point' the conclusions to make them stand out. Take a look at some of the past papers in the journal.

Referencing protocols

There are several referencing protocols and you must follow the one used by your selected journal. Harvard and Vancouver styles are common although different journals have their own style which may be a combination of documented styles, making it rather confusing for authors. Nevertheless the style required by your target journal must be followed precisely; you cannot expect the editor or the editorial team to adapt your referencing system – the paper

will be returned to you for revision and could be one of a number of issues which leads to the rejection of your paper.

Fundamentally, referencing is a way of indicating your sources in the body of your paper and listing more details at the end. The purpose is to allow readers to see easily what sources you have used and to give sufficient information for them to conveniently locate the source. Whole textbooks are written on the topic of referencing (see below) and thus in this short paper we will give a brief outline of the system used by JEHR, which is based on the Harvard system.

Referencing in the body of the text

Within the system described here, there are several ways of citing (or acknowledging) the work of others in your text. You can simply refer to the work in the course of your discussion:

Some studies take this further and suggest issues that could be included in health promotion strategies (Griffith, 1995) or discuss the barriers to changing behaviour that need to be overcome if health promotion is to be effective (Frewer et al. 1994a; 1994b; 1997, Miles and Johnson, 2006).

Note the use of 'et al.' if there are more than two authors. This applies to citing in the text only. All authors must be included in the reference list at the end. Note also the use of a, b etc when referring to more than one paper with the same authors and the same year.

Or you can use a short quote:

Fleming and Harvey (2002) define work-related violence as "an action or perceived intention of a perpetrator which results in the threat of, or actual injury (physical and/or psychological) to the victim in the course of their work".

Note that you don't include the authors' initials here. Page numbers are not normally included in the text if you are citing a journal article, as the full details will be given in the reference list. However, if you are citing from a text book, it is usual to give the page number in the text here e.g. (Donaldson, 2007, p119).

The reference list or bibliography

This provides information on all the sources cited in the text and appears as a list at the end of your paper presented in alphabetical order of authors. The presentation is slightly different depending on where the source is to be found. In the following examples take careful note of the use of capital letter, italics, commas, periods and brackets.

Journal paper or article:

Wright M L and Pheby D (2006) Risk Factors for Osteosarcoma in Young People in Cornwall: A Case-Control Study. Journal of Environmental Health Research, 5(2), 61-69.

A book:

Stewart J, Bushell F and Habgood V (2004) Environmental health as public health. London, Chadwick House Publishing.

Chapter in an edited book:

Fleming P (1999) Health Promotion for Individuals, Families and Communities. In Long A (ed) (1999) Interactions for practice in community nursing. Basingstoke, Macmillan. pp 228-59.

Government sources:

Government of Ireland (1997) Sustainable Development; A Strategy for Ireland. Dublin, Government Publications.

Legislation:

Government of Great Britain (2006) Climate Change and Sustainable Energy Act 2006, Chapter 19. London, The Stationery Office.

*Web Site (*this aspect of style is still developing and there are many variations):

Trades Union Congress (2003) Union safety reps call for better health and safety training for bosses and workers [accessed 9 May 2003].

Newspaper article: Daily Telegraph, 2007. Avian Influenza suspected in the UK.

Daily Telegraph, 24 January, p.2a. References HDA (2002) Environmental Health 2012: A key partner in delivering the public health agenda.

London, Health Development Agency.