Analysing the awareness and comprehension of pictograms as a hazard communication mechanism to reduce child exposure to chemicals in South Africa

Tatum Louw
LWXTAT001

Submitted in partial fulfilment of the requirements for the degree Master of Public Health at University of Cape Town.

September 2020

Supervisor: Professor Hanna-Andrea Rother

Institution:
Environmental Health Division
School of Public Health and Family Medicine
Health Sciences Faculty
University of Cape Town
South Africa

University of Cape Town • iYunivesithi yaseKapa • Universiteit van Kaapstad
SPES BONA

The copyright of this thesis vests in the author. No quotation from it or information derived from it is to be published without full acknowledgement of the source. The thesis is to be used for private study or non-commercial research purposes only.

Published by the University of Cape Town (UCT) in terms of the non-exclusive license granted to UCT by the author.

University of Cape Town

DECLARATION

I, Tatum Louw, hereby declare that the work on which this thesis is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university.

I empower the university to reproduce, for the purpose of research, either the whole or any portion of the content in any matter whatsoever.

Signature: T J Louw

Date: 7 September 2020

DEDICATION

This thesis is dedicated to the cornerstone in my life, Jesus Christ, my parents, Amanda and Eugene, my sister, Taryn and my partner, Tyron. You inspire me to always do my best and support me in everything I do, and for that, I am forever grateful.

ACKNOWLEDGEMENTS

2 Corinthians 9:8

And God is able to make all grace abound to you, so that having all sufficiency in all things at all times, you may abound in every good work.

The gratitude I have for everyone who has walked this journey with me is overwhelming and I bless you with the verse above to extend my thanks. The following people in particular, I would like to acknowledge and thank:

- Thank you to my family (Amanda, Eugene, Taryn and Tyron) for their support and encouragement throughout my MPH, it has given me strength to continue during many challenging times.

- A big thank you Professor Andrea for your brilliant mind and supervision on this mini-dissertation. Your passion for people and the environment translates into everything you do and has guided me in this process.

- Thank you Ms. Perera and Mrs Bennin for helping me proofread at the end, it is truly appreciated.

- And last but not least, thank you to the farmworkers who participated in the study and welcomed me on the farm during the interviews and the students who completed my questionnaire.

ABSTRACT

Hazard communication mechanisms are essential for informing child caregivers of the dangers associated with chemical products. However, for caregivers to protect their own health and their children from the harm of toxic chemicals, it is important that they understand label information as scientifically intended. Therefore, to accommodate parts of society that have a lack of access to education, the placement of hazard communication pictograms on labels have been introduced to overcome literacy barriers. Many research studies have been conducted on the comprehensibility of pictograms and have found that many barriers exist in end-users being able to understand the intended message behind the pictogram. This study, therefore, explores further the awareness and comprehension of pictogram comprehensibility among caregivers in South Africa that have different backgrounds and living experiences. The study employed a mixed-methods cross-sectional design. The study was conducted with farmworkers from a farm in Paarl and students from the University of Cape Town. Two different data collection tools were used: a face-to-face questionnaire was administered to farmworkers (taking into account literacy barriers) and an online questionnaire to students due to unforeseen circumstances (COVID-19), that put a pause on face-to-face questionnaires being administered among UCT students. Both groups received the same questions except for small adjustments made to the online questionnaire to accommodate the platform. Data for the face-to-face questions were stored in the data collection application, CommCare, and transferred to Excel for quantitative analysis. The online questionnaire was administered through a Google form that was emailed to all students at the university by the Department of Student Affairs and data were then transferred to excel for quantitative analysis. The qualitative data were analysed using a thematic analysis approach where themes were created from theory in the literature and word repetitions that emerged from the respective group responses. Based on the overall results, comprehension of the pictograms varied greatly between caregiver groups indicating harmonization is necessary. Although beyond the scope of this study, the difference amongst the perception of danger warrants further analysis on whether age, educational level, perception of danger, lived experiences, and environmental exposure play a role in the two groups' comprehension of pictograms. The study focused on the already existing Globally Harmonized System of Classification and Labelling of Chemicals (GHS) pictograms as well as newly proposed ones to communicate the “Keep out of reach of children” message. Based on the overall results, what the pictograms represented varied greatly between the different caregiver groups, indicating that comprehension differs largely, and harmonization has not been entirely achieved as desired by the GHS. However, the study concludes that participants place responsibility on the chemical industry to make information about the harmful effects about their products more accessible to communities through educational talks, social media, experts at the point of sale to explain any potential hazards, and through the use of billboards and flyers. Though difficult to achieve, it is suggested that conversation amongst chemical legislators and industry commence on how to include the voice of end-users in the development and implementation of hazard communication strategies.

Table of Contents

DECLARATION **2**

DEDICATION **3**

ABSTRACT **5**

PART A PROTOCOL **8**

SECTION ONE: Introduction **8**

1.1 Background *8*

1.2 Problem statement *9*

SECTION TWO: Literature review **12**

2.1 Use of pictograms for risk reduction *12*

2.1.2 Pictograms on chemical GHS labels *13*

2.1.3 Advantages of Pictograms 13

2.1.4.1 Education levels and comprehensibility of pictograms 15

2.1.4.2 Street pesticides *16*

2.2 Theoretical concepts *17*

2.2.1 Cultural Capital theory 17

2.2.2 Semiotics theory and symbolism 18

2.3 Industry's reason for the use of pictograms 20

2.4 Risk perception and how this influences understanding of label information *21*

2.5 Gaps in the literature. *22*

2.6 Aim *23*

The aim of the study is to assess the comprehension of GHS pictograms among child caregivers in preventing adverse health risks linked to children's exposure to chemicals. **23**

2.7 Main research question *23*

2.8 Study Objectives *23*

The objectives to address the study aim are: **23**

3.2 Study population and sampling *24*

3.2.1 Study location 24

3.3 Sampling strategy *25*

3.3.1 Purposive sampling 26

3.3.2 Convenience sampling 26

3.4 Data collection (Appendix 3/4 /11) *27*

3.5 Data management *28*

3.6 Sub-methodology due to global COVID-19 outbreak *28*

3.6.1 Study location during COVID-19 pandemic *29*

3.6.2 Data collection tool *29*

3.6.3 Sampling strategy during COVID-19 pandemic *30*
3.7 Data analysis for whole research study *30*
3.8 Logistics and time schedule *31*
3.9 Limitations *31*
3.10 Pilot *32*
3.11 Ethical considerations *32*
3.10.1 Voluntary informed consent (Appendix 1.1/1.2) 32
3.10.2 Privacy and confidentiality 33
3.10.3 Potential risks 33
3.10.4 Permission to conduct research at locations 33
References **34**
PART B JOURNAL MANUSCRIPT **41**
Abstract *42*
1. Introduction *43*
2. Methods *50*
3. Results *57*
4. Discussion *84*
5. Conclusion *92*
Appendixes **102**
Appendix 1.1 English Consent form *102*
Appendix 1.2 Afrikaans Consent form *105*
Appendix 1.3 Online consent form *107*
Appendix 2.1 Lamination sheet with pictograms *108*
Appendix 2.2 Lamination sheet 2 with pictograms *109*
Appendix 3 English questionnaire *110*
Appendix 5 Pesticide information label pictogram and colour code sheet in English *124*
Appendix 6 Pesticide information label pictogram and colour code sheet in Afrikaans *125*
Appendix 7 Point chart with existing chemicals and pesticide products *126*
Appendix 8 Pictures of chemical product labels *128*
Appendix 9 Nine Pictograms with descriptions *130*
Appendix 10: Option to exit survey *131*
Appendix 11: Online Questionnaire *132*
Appendix 12 Author Environmental Research Journal Guide to Authors *163*
Appendix 13 HREC Approval *181*

PART A PROTOCOL

SECTION ONE: Introduction

1.1 Background

Every year, over a million acute poisoning cases are reported worldwide (Poojari*, et al.,* 2019). The World Health Organisation (WHO) reported that approximately 193,450 deaths were caused from unintentional poisoning in 2012. Furthermore, according to Schwebel, et al., (2017), unintentional child poisoning comprises a large component of public health concern worldwide demanding increased intervention. Particularly in South Africa, researchers have found that during 2003-2008 a large number of cases of chemical poisoning among children (2872) were presented to the Red Cross War Memorial Children's Hospital (RCWMCH) in Cape Town, South Africa (Balme, et al., 2012). The study also found that the main toxicants linked to these incidents were household cleaning chemicals, pesticides, paraffin, and drugs (Balme, et al., 2012). As RCWMCH is a referral hospital (poisoning cases are referred to the hospital from other primary health care facilities across South Africa), it is likely to receive patients from around the nation, representing different parts of South Africa. As adult caregivers are responsible for the safety of children prenatally as well as during the course of the child's entire childhood, caregivers should be equipped for the proper use of chemicals in their households (Bellinger, 2013). An issue that arises with this however, is in finding a way to educate caregivers, as unsafe practices in the household can lead to increased chemical exposure among children.

According to Dionisio, *et al* (2015) multiple routes of chemical exposure exist (through air, soil, water) that can cause windows of vulnerability for exposure among children which can lead to them experiencing adverse health risks. A large area of concern is that chemicals enter the human body through inhalation, skin absorption or ingestion which can cause irreversible and permanent health effects (Dionisio, *et al.,* 2015). Thus, the awareness of chemical hazards among individuals, particularly caregivers, is important to safeguard them and their children from exposure in different settings (for example, hazardous chemicals in their work, home, school environment and other spaces in their environment) on a daily basis. As children and adults are both indirectly exposed (e.g., through chemicals in the air, soil or water due to pesticide run off from farms) and directly exposed (e.g., incorrect use of household pesticides or chemical product) (Sosan & Akingbohungbe, 2009), chemical safety behaviour in South Africa should be emphasised and encouraged.

Direct exposure pathways can be associated with the lack of correct chemical safety behaviour i.e. handling pesticides without the proper personal protective equipment or not reading chemical labels and can be controlled on an individual level (Gaber & Abdel-Latif, 2012). According to Gaber & Abdel-Latif's (2012) study on the safe use of chemicals amongst an agricultural group

in Egypt, when farmers have an internal sense of having a high level of control over their behavioural practices, it is more likely that they will adopt pesticide safety behaviour. Similarly, a study done by Andrade-Rivas & Rother (2015) on reducing chemical exposure found that a key factor impacting non-compliance of PPE amongst workers were that workers had a perceived lack of personal control over their health choices and would imitate safety practices displayed by people in positions of power. It is important to uncover the barriers towards people's non-compliance to chemical labels and how to increase their perceived sense of control over their health and wellbeing. However, uncovering the barriers to people's understanding of chemical labelling cannot be done in isolation to existing global and national chemical regulations. Regulation regarding chemical labelling can serve as a foundation to improving comprehensibility by providing adequate guidelines to address the challenges around comprehension experienced by end-users.

1.2 Problem statement

A large chemical group that falls under the umbrella term of chemicals, and which is frequently used in South Africa, especially in farm settings, are pesticides (Hancock, *et al.,* 2008). According to the WHO (2018), pesticides are referred to as any substance or mixture of substances that is made up of chemical or biological ingredients used to destroy, control or repel any form of pest or regulate plant growth. Rother (2014) argues that the extensive use of pesticides across sectors (agriculture, borders, forestry, leisure areas, public places like hospitals and schools) and within households (pest control) results in an increased exposure to hazardous chemicals that can negatively impact people's health. The focus of this study will therefore, be on the 'pesticide' chemical group because of the high exposure risk for the South African population.

In South Africa, laws such as the Fertilizers, Farm Feeds, Agricultural Remedies and Stock Remedies Act, 1947 (Act No. 36 of 1947), Hazardous Substances Act, 1973 (of which the latest regulation of the government notice 1242 is dated 14 October 2016), and the Occupational Health and Safety Act (OHSA), 1993 (Act No. 85 of 1993) govern pesticide life-cycle stages (including packaging). South Africa ratified the Rotterdam Convention in 2004, which promotes shared responsibility of the importation of hazardous chemicals (including pesticides) between countries and implemented the Globally Harmonized System of Classification and Labelling of Chemicals (GHS) in 2012. Acknowledging that there are both national and international guidance for pesticide regulations, there is a need to identify, at a grassroots level, whether end-users are able to easily understand the hazard and risk information found on chemical labels in order to protect themselves and their children. It should not be assumed that people's access to information automatically results in their comprehension of the hazard information (Rother, 2018). Furthermore, there is a need to differentiate between different types of chemical information that

is provided to the public in order to avoid confusion. For instance, the difference between hazard and risk communication is that hazard communication refers to the information provided about the substance that causes harm whereas risk communication refers to the process wherein people are informed about hazards associated with an exposure, and have the purpose of effecting an influence on behaviour change (Rother, 2014).

It is assumed that access to information in the postmodern society is easily retrievable; through many different platforms using the Internet (West, 2015). However, despite the rise in technology that allows individuals to access information on the internet to become further cognisant of chemical terminology, it should not be assumed that the internet is easily accessible. West (2015) argues that for lower-income countries, factors such as poverty, data and telecommunication costs, digital literacy issues and operational barriers can lead to the lack of Internet access for many people. Internet use and the usage of electronics (such as mobile phones, laptops and computers) to access search engines can still be considered a luxury in many lower-income countries. Acknowledging the barriers experienced by people to access information, hazard communication should therefore be easily understandable and should not require further research from end-users. The assumption made by chemical companies (industry) is that through placing information labels on chemical labels and having safety data sheets, people will be successfully "informed" about the hazards and risks associated with products. According to Rother (2014), chemical information that is communicated to the public end-users should not use scientific jargon or be articulated in a way that is not understood by the general public.

As precautionary statements on pesticide labels are often an insufficient stand-alone medium to communicate hazards to consumers, pictograms are also provided. Many barriers such as cultural practices, language differences and access to quality education are associated with end-users effectively understanding pesticide labels. A study conducted among 115 South African farmworkers found that approximately 52% of the participants were unaware that pesticide labels contain warning and advice pictograms (Rother, 2008). One of the causes of this was the low level of awareness and comprehension of the hazard communication methods on pesticide containers. Despite pesticide labels providing access to risk and hazard information, a key issue is the limited understanding and knowledge individuals have of the technical information presented (Rother, 2008). This miscomprehension of chemical labels therefore leads to the absence of necessary safety practices.

In order to address barriers that exist with chemical labels and protect human health and the environment, the Globally Harmonized System of Classification and Labelling of Chemicals (GHS) was developed by the United Nations (UN), providing a harmonised system of labelling chemicals (UN,2019). The GHS task teams examined existing global systems (United States and

Canada's workplace, consumers and pesticides; the European Union's directives for classification and labelling of substances and preparations and the United Nations' recommendations on the transport of dangerous goods) to inform the expansion of the GHS handbook (UN,2019). The first handbook was completed in 2001 with the latest 8th edition released in 2016 (UN,2019). The GHS is adopted by countries on a voluntary basis, of which South Africa promulgated in the beginning of 2019. An essential factor towards the success of the GHS is the user-friendly label suggestions. One of the long-term goals of the GHS is that it will appear on all chemical labels, where relevant, in the near future and be comprehendible by people in different country-contexts and languages.

Comprehensibility of the GHS by adult caregivers is essential to promote the reduction of children's hazardous exposure to chemicals. Due to incorrect pesticide safety practices, not only are risks posed on adults working with harmful pesticides and chemicals, but also their children, through take-home exposure (Naidoo *et al.,* 2010). The concern of child exposure is that children's bodies are more vulnerable than adults' to toxic pesticides due to their biological sensitivity (Landrigan & Etzel, 2013). Throughout the lifespan of a child, their bodies are continuously developing, and exposure to highly hazardous pesticides can result in irreversible or permanent life-threatening health complications/conditions associated with injury to the brain, immune system, reproductive systems and other important organs (Landrigan & Etzel, 2013). Children inhale more air in relation to their body weight and height and have a larger surface area to volume ratio which increases dermal exposure (Sly & Flack, 2008). There is therefore, a great need to limit children's exposure to hazardous chemicals in order to safeguard them from the harm that could be caused. As chemical products and pesticides form a part of daily life, there should be adequate hazard communication relayed to caregivers of children and to children themselves as they key problem for South Africa is that children are exposed to the harmful health effects of household chemicals and pesticides on a daily basis. Therefore, the focus of this research project will be to identify whether pictograms are an effective hazard communication mechanism among child caregivers living in South Africa, to mitigate against the adverse health effects of chemical and/or pesticide exposure for their children".

SECTION TWO: Literature review

2.1 Use of pictograms for risk reduction

2.1.1 Hazard communication and Risk communication

The terms hazard communication and risk communication are both important concepts to be understood within the environmental health discipline as they both communicate the dangers associated with the product. The two terms however, are commonly misunderstood and the distinction between the two terms "risk" and "hazard" can be an issue if used interchangeably by chemical producers and policy makers (Scheer, *et al.,* 2014). Therefore, it is important to understand the two concepts individually as well as how they informs each other in order to unpack the dynamics of pictograms and guide their comprehensibility. Before dissecting the communication aspect of the two terms, understanding what *hazards* and *risks* are, is a good basis to begin with. A hazard can be defined as the potential to harm the environment and/or human health*,* whereas risk can be defined as the probability of a human or the environment being exposed, and the extent of the damage caused as a result of the exposure (Sheer, *et al.,* 2014).

Bearing in mind the definition of a hazard including the potential harm, when applied to chemicals, it is worth pointing out that chemicals can have different properties, which in return have varying degrees in which they can be a hazard to human health and the environment (Sathar *et al*., 2016). As pesticides are comprised of a mixture of chemical products, they can have an array of health effects that people are at risk to when exposed to them. However, this depends on what the chemical structure of the pesticide is at time of use (Quinn et al., 2011). Persistent pesticides refer to pesticides that cannot degrade through metabolic activities, extreme temperatures and ultraviolet radiation. These types of pesticides are typically found within organochlorine insecticides such as Dichlorodiphenyltrichloroethane (DDT) and cyclodiene insecticides (Quinn et al., 2011). As a result of their environmental persistence, people are exposed to these pesticides for prolonged periods. DDT (Organochlorine), is an endocrine disrupting pesticide that affects the nervous system, causes birth defects of infants born to exposed females as well as their neuroendocrine systems (Gilden et al., 2010). The different health effects that are caused by the different active ingredients in pesticides alone, reinforces the importance of hazard communication being specific and relevant to each product. Therefore, the existing hazard symbols to communicate the various hazards include pictograms which represent oxidizers, explosives, corrosives, gases under pressure, flammable, toxic to aquatic organism and causing long lasting environmental effects, acute toxicity, chronic toxicity and irritants. In light of the differentiation between the two terms, hazard and risk, it is common that a hazard informs the risk. Therefore, hazard communication is an important element to focus on, as it influences the appropriateness and effectiveness of risk communication for different types of audiences (market, occupations dealing with chemicals and community members).

2.1.2 Pictograms on chemical GHS labels

At the Rio Earth Conference hosted by the United Nations in 1992, the Agenda 21 Report addressed sound management of toxic chemicals that included dissemination of information (Winder et al., 2005). A successful method to disseminate information to end-users includes the use of chemical labels. Chemical labels are intended to guide end-users in the application of the chemical product with no or minimized risk effects for humans and the environment, as well as obtaining the desired chemical effect (Webster *et al,* 2018). Every country has its own set of regulations regarding chemical labelling and therefore problems during importation and exportation of chemicals. In order to address this, in 2003, the GHS was recommended by the United Nations to standardize labelling across different countries (Hara *et al., 2007*). The benefits of harmonization are that it facilitates international trade through the promotion of consistent national requirements on how to classify chemical hazards, and communicates a criterion that companies engaging in international trade, should meet (UN,2019). However, in order to maximize the facilitation of harmonizing chemical labels, it is essential that there is easily comprehensible information on labelling. To ensure this, the GSH has stipulated standards for labelling requirements. One of these requirements is the inclusion of pictograms.

Pictograms were introduced with the intention of reducing and simplifying information that is highly technical or scientific (Webster *et al,* 2018). The function of a pictogram is to provide a visual representation of verbal information as a safety precaution measure. However, the fidelity of the intention of pictograms to communicate verbal information is not often successful. According to Laughery & Wogalter (2014), design factors, such as colour, size, format and signal words, together with non-design factors, such as context and location of a pictogram, is essential for compliance. However, despite the intention of pictograms being advantageous on chemical labels for compliance, there are also some disadvantages; both advantages and disadvantages are therefore, important to consider when evaluating whether pictograms are effective measures for conveying information on chemical labels.

2.1.3 Advantages of Pictograms

Communication through symbols and pictures has evolved throughout human history and its importance to humanity's existence is highly significant. People come into contact with pictograms through road signs, medication instructions, computers and appliances on a daily basis (Tijus, *et al.,* 2007). Despite the multifaceted use of pictograms in various settings and contexts, they can be seen to maintain one common goal: communicating a message in an easily identifiable picture form. Pictograms are useful as they consist of figures and concepts that relay information in a simple, concise, and expeditious manner (Barros, *et al.,* 2014). It is thus a global

appeal to use pictograms on chemical labels in order to overcome many barriers to information sharing.

Pictograms have a global appeal for international chemical trade purposes as they communicate the dangers associated with specific chemicals in order to elicit the appropriate use, storage or disposal responses by those that come into contact with the chemicals (Banda & Sichilongo, 2006). Furthermore, pictograms can be considered desirable for global use on chemical containers as they can communicate important information to vulnerable communities with low health literacy levels (Laughery & Wogalter, 2014). Health literacy is described as the extent to which individuals have the ability to gain, process and comprehend the most basic information associated with a product in order to make a decision about their health (Barros, *et al.,* 2014). This addresses a global need for chemicals that are exported and imported from countries that have different characteristics, health literacy statuses and languages. In support of the notion of the comprehensibility of pictograms, researchers have found that study participants in South Africa, Cape Town, recommended that the use of pictograms be increased to assist individuals who cannot read or understand text information (Bennin & Rother, 2015). It can therefore be deduced, that because of their ability to overcome reading barriers, pictograms can be used to communicate a hazard to people speaking different languages from different countries. Pictograms have therefore been found to assist in overcoming the aforementioned barriers and, as a result, the GHS is proposing the inclusion of labels on chemical bottles. It allows people on a global scale to have access to the same hazard communication on a firsthand basis. However, according to Rother (2008), there is an assumption that through providing risk communication on chemical labels, that end-users are able to make better decisions regarding risk management, but that is not always the case.

2.1.4 Poor comprehensibility of pictograms

Despite pictograms overcoming practical barriers such as end-users not being able to read the writing on chemical bottles, misunderstanding words and lack of visual stimulation, they still have their limitations globally. A study that analysed participants' level of understanding of chemical hazard labels in Zambia, found that among 364 participants, there were low comprehension levels and many did not know a symbol as old as the "St. Andrews Cross" (Banda & Sichilongo, 2006). A review by Emery *et al* (2015) included three studies that yielded significant results on compliance and comprehension. One of the studies included in their review was among Greek tobacco farmers (Damalas et al., 2006) and it found that 94% of their participants found pesticide labels hard to understand. The second study, by Waichman et al. (2007) conducted amongst Brazilian farmers, reported that the majority of the participants found pesticide label fonts difficult to comprehend because of the font being too small and the wording

being too technical. Lastly the third, conducted in the United Kingdom, found that the placement of pesticide safety information, together with language used, had an influence on the degree of compliance by the respondents to the warning label (Edworthy et al., 2004). Emery *et al* (2015) concluded that from the three studies on pictogram understanding and compliance included in their review, the comprehension of the pictograms across studies was low. Emery *et al* (2015) argue that pictograms require the observer to remember the intended meaning in order for it to be effective worldwide.

Thus, as seen in the literature, a disadvantage of pictograms as a hazard communication mechanism is associated with end-users' ability to comprehend the message accurately (Emery *et al.,* 2015, Banda & Sichilongo, 2006, Dowse 2004). The idea that pictograms promote safety behaviour as they are imprinted in the sub consciousness of the end-user is flawed and should not be generalized for all people. One element of pictograms, their colour, according to Montagne (2013), can hold different cultural meanings to different people, therefore influencing their comprehension of the pictogram. Additionally, Montagne (2013) argues that although pictograms make hazards more noticeable, this is largely dependent on the pictograms size and positioning. Therefore, the challenge presented by pictograms can be found within its characteristics (compact form of information, colour, size and picture used to illustrate a verbal instruction) that is supposed to make it "advantageous" but has the opposite effect. If people are not able to understand the descriptive instruction given by the symbol on the chemical label, the pictogram fails to deliver its purpose.

2.1.4.1 Education levels and comprehensibility of pictograms

A prominent barrier toward pictogram comprehensibility is different educational level of end-users. Ehlers and Dowse (2004) argue that people with literacy barriers are less likely to comprehend and be compliant to verbal and written instructions provided by health-care workers. The intention of the use of pictograms is to stimulate one's imagination and offer an alternative for people to recall instructions (Ehlers & Dowse, 2004). Comprehension skills through the use of one's imagination and the ability to process what is being communicated are both skills learned through formal education.

The association between low literacy and poor health choices is recognized and observed across LMICs (Ehlers & Dowse, 2004). Particularly, in South Africa, due to the ripple effect of the apartheid regime that ended in 1994, previously disadvantaged groups still face barriers to quality education and have less access to resources. Therefore, when reviewing which pictograms to add onto all chemical products as the GHS intends, the educational level of all people needs to be taken into account. A study conducted by Sathar, *et al* (2017) found that participants who obtained a diploma or tertiary education were more likely to remember the environmental hazard

symbol than those with no tertiary education. Furthermore, a study conducted with farmworkers in India found a statistically significant correlation between the educational status of the workers and their interpretation of the risk labels on pesticide bottles (Chendrashekaran, 2017). Education attainment and the lack thereof can thus pose a barrier towards safe chemical usage behaviour, particularly if people cannot read or write and have dropped out of school prematurely.

2.1.4.2 Street pesticides

An emerging problem faced within lower-income communities is the use of street pesticides. A study conducted among pregnant women in both rural and urban settings in Western Australia (a considerably higher income country) who were non-occupationally exposed to pesticides, found low concentrations of pesticides in their blood samples (Reid *et al.,* 2012). Lower-income communities therefore, are more likely to face the burden of pests due to their living conditions and the lack of appropriate health and/or social services available. Presented with the need to urgently manage pest infestations, paired with financial constraints, results in people purchasing street pesticides which in turn leads to exposure to their toxic contents, as they may be unaware of the hazards associated with them (Balme, *et al.,* 2010).

In South Africa, households are faced with the silent and alarming challenge of pest infestations (Rother, 2016). According to Rother (2016), in an attempt to address the burden of these pests, an informal sector within some South African communities have started the sale of pesticides that are illegal and highly toxic with no labelling on them. In South Africa, a pesticide is considered to be illegal when it does not contain the statement "Act 36 of 1947" on the label. The Fertilizers, Farm Feeds, Seeds and Remedies Act 36 of 1947 in South Africa regulates the registration of pesticides and therefore mandates what pesticides can be sold and their legality for use. Furthermore, Act 26 of 1947 sub-section 6 stipulates, "No person shall sell any fertilizer, farm feed or remedy unless – the container in which it is sold complies with the prescribed requirements and is branded, labelled, marked, or sealed in such a manner as may be prescribed". Additionally, Rother (2016) argues that although some pesticides sold on the street are legal in South Africa, problems arise when pesticides that are used only in the agricultural sector (and are not registered for household use) are used in households, as they have a highly acute toxicity.

Street pesticides pose a great barrier toward hazard communication in lower-income households as end-users do not always receive information on the product, and in turn, are not in a position to make informed decisions. Additionally, street pesticides compromise comprehensibility of pictograms as people are not exposed to the pesticide label and the image is therefore not reinforced in the sub-conscious. Children's health is put at risk as they can easily be exposed to street pesticides when made accessible and sold for a cheaper price, and as a result, easily enter households where children live (Rother, 2016). A retrospective study conducted by Balme *et al*

(2010) between the years 2003-2008, found that of the 2868 poisoning and paediatric exposures of children admitted to Redcross War Memorial Children's Hospital, 306 patients presented with 311 incidents of acute pesticide poisoning as a result of exposure to street pesticides.

2.2 Theoretical concepts

When considering the factors that will influence comprehensibility of pictograms, the two theories of importance are cultural capital and semiotics theory. The former is necessary as it explains the factors associated with people's environment that influences their pictogram comprehensibility, whereas the latter, will be used to explain the pictogram itself and how it has an influence in comprehensibility. The particular concept, cultural capital, is an important framework to be considered when analysing the effectiveness of hazard communication as it can be deduced that culture plays a significant role in people's behaviour patterns. There is a link between culture and comprehension as an individual's knowledge and attitudes can influence their decisions on prevention, care and support that are in line with their culture (Airhihenbuwa & Webster 2004). Cultural capital will therefore be used to analyse how learned behaviour (people's social circles, upbringing and community influence) influences people's current chemical safety practices and whether it will hinder or support their ability to comprehend pictograms. The second theory, Semiotics, is important to inform the analysis, as it will provide guidance on how the pictogram in itself (as a sign) facilitates or hinders comprehensibility. By using the two theories to inform this research, the effectiveness of pictograms as a hazard communication mechanism can be more closely determined, based on factors associated with people and the pictogram. It is critical to analyse factors linked to people and the pictogram as both play important roles in facilitating comprehension.

2.2.1 Cultural Capital theory

Cultural capital falls within the theory of capital, which encompasses economic capital, social capital and cultural capital, and can be seen as a resource that is useful for individuals to both acquire and maintain a good health status (Pinxten and Lievens, 2014). Relevant to this research, is cultural capital, as Pierre Bourdieu's theory argues that cultural capital is gained through accessing an education system and furthermore, university, and the understanding of how to use language that is "educated" (Sullivan, 2002). Cultural capital has three main components: (1) institutionalised capital (educational level), (2) objectified cultural capital (possessing cultural goods) and (3) embodied cultural capital (the values, knowledge, skills of individuals) (Pinxten and Lievens, 2014). Though all three components hold equal weight in the construct, to better understand the comprehension of pictograms, an individual's level of education and their learned values and knowledge are relevant components to dissect.

People's understandings of pictograms are linked to external factors such as their environment, culture and beliefs (Airhihenbuwa & Webster 2004). The three aforementioned external factors; environment, culture and beliefs can either hinder or promote people's understanding of pictograms. Firstly, the environment people live in can hinder comprehension if they have different structural capacities (for example, house layout or room co-ordination). Pictograms can therefore pose a barrier in comprehension if people are not aware of certain behavioural practices the pictogram is intending to communicate, such as the GHS symbol in which a chemical product is locked in a high cabinet out of reach of a child. The aforementioned pictogram assumes that all people's environments are the same (informal non-brick house compared to a formal brick house and space within the house). This can hinder compliance to the pictogram, as people are unable to exactly follow out the intended behaviour due to having a different environment.

Secondly, cross-cultural differences can contribute toward misinterpretations of the intended message that hazard communications aim to deliver (Sathar, *et al.*, 2017). South Africa has a rich diversity of cultures embedded in different societies. Within these cultures not only is there a strong reverence to one's language within the community but also to daily practices which people have become accustomed to. Airhihenbuwa and Webster (2004) argue that culture has been shown to have both positive and negative influences on health behaviours. People within different communities can have different ideas of what is perceived to be positive behaviour versus negative behaviour. The third factor is users' belief-systems. According to Mayer *et al* (2010) the beliefs farmworkers hold about pesticides are crucial determinants of how they will carry out certain behaviours. Comprehension of pictograms can be hindered when people hold strong beliefs about chemical safety due to internal factors. According to Ajzen (2011), despite individuals having information about certain behaviours, the beliefs they hold about that behaviour could be based on information that is inaccurate, premised on faulty or irrational ideas, biased and influenced by their own self-serving motives, as a result of fear or other emotions, and lastly, could fail to reflect reality. In other words, individuals that may have information regarding safe chemical behaviour might be inhibited from carrying out the behaviour the pictogram intends to communicate due to their belief system. The concepts of the individual's environment, culture and beliefs should be taken into account when creating pictograms in order to analyse the effectiveness of pictograms amongst all people. In order to promote understanding, caregivers should be targeted as they are in a position to have an influence over what is considered a norm for chemical safety practices, procedures, and communications, and therefore they can inhibit or stimulate communication (Cigularov *et al.,* 2009).

2.2.2 Semiotics theory and symbolism

The study of information design is centred on using effective strategies such as symbols and words to communicate a particular message (Sharp, 2011). The semiotics theory by Charles

Sanders Peirce refers to the interface of a pictogram's design and its interpretation (Korenevsky, *et al.,* 2013). In the signage systems, a pictogram is regarded as an iconic sign that is aimed to help improve all communication processes (Hassen, 2015). A factor contributing to the lack of comprehension of pictograms on pesticide containers can be the design of the pictogram. In order for a pictogram to be easily noticed, design plays a key role. According to Laughery and Wogalter (2014), colour, size and the location of pictograms can result in a pictogram's ineffectiveness and obstructs end-users from noticing them. Findings from a study conducted among farmworkers in India, resulted in researchers concluding that it is necessary for pictograms to have more colour, be clear, large and designed in a manner that reflects cultural beliefs of various people (Korenevsky *et al*., 2013).

Another important principle of the semiotics of Charles Peirce's theory is that everything can be transformed into a sign, however the sign must have the ability to represent the individual's thought and interpretation (Yakin *et al*., 2014). In order to examine the effectiveness of a pictogram as a sign, data on how people comprehend what they physically see and interpret from the design element is important to inform the research being done. A pictogram can be designed in a particular way that is scientifically substantiated (conveys accurate and correct messages) however, if the elements are not well placed or generalized; it has the risk of being interpreted differently by different people. A pictogram does not have an inherent meaning but is assigned a meaning by the creator of it (Hassan, 2015). Therefore, when designing a pictogram, the elements (colour, size and symbols used) must reflect a meaning with which people can easily identify.

A pictogram is described as a "graphical composition that may include a symbol plus other graphic elements, such as a border, background pattern or colour that is intended to convey specific information" (GHS, 2018). When assessing comprehensibility, it is thus important to understand whether the pictogram in itself, as a symbol, is the obstacle towards users' ability to comprehend it, and not the other way around, where the challenge to comprehend lies within the user only. Therefore, when considering pictograms as warning signs to convey life-threatening information, it is important that the symbol (pictogram) is designed in a way that maximises an individual's ability to initially comprehend it and provide subsequent learning (Lesch *et al.,* 2011). Currently, the GHS for chemical products provides strict outlines on how a pictogram should appear. The GHS handbook specifies that a pictogram's shape must be in a square set at a point and include the colours white, red, and black (UN, 2019). Though the symbol guidelines allow for harmonisation across different countries implementing the GHS guidelines, various factors should be considered with regards to the design, in order to increase comprehensibility.

According to Lesch *et al* (2011), the design of warning symbols should additionally be sensitive to cognitive changes (changes to memory, attention and language) that are associated with

ageing. Research was conducted assessing both an individual's age and educational level and pictogram use, and found that among the older adult cohort, in comparison to younger adults, a declining abstraction and logical ability had lower pictogram assessment scores (Beaufils *et al.,* 2014). Similarly, a study conducted in the central rail hubs of Taiwan on the effect of age on symbol comprehension, there was greater difficulty in comprehending certain symbols among the older cohort, in comparison to younger adults (Liu and Ho, 2012). As adult caregivers can range from young to older parents or grandparents, the design of pictograms is important to consider when assessing comprehensibility.

2.3 Industry's reason for the use of pictograms

In order for pesticide products to be legally sold in South Africa, there are different regulations that industries need to comply with before they can distribute the product. The legislation that governs pesticides in South Africa is the Fertilisers, Farm Feeds, Agricultural Remedies and Stock Remedies Act, 1947 under Act No. 36. According to the aforementioned regulation, legally registered pesticides must have an approved label on it before it can be sold.

South Africa adopted the Pesticide Management Policy under the Fertilisers, Farm Feeds, Agricultural Remedies and Stock Remedies Act in 2010. According to the policy, it is the responsibility of the Department of Agriculture, forestry and fisheries to ensure that all registered pesticides are labelled correctly in order to ensure that the necessary information is notably displayed and presented in a way that allows end-users to understand the risks associated with the product and be able to make a judgement as to how they should respond to it. According to Act 36 of the Fertilisers, Farm Feeds, Agricultural Remedies and Stock Remedies Act, 1947 guidelines on labelling of stock remedies in South Africa labelling, section 7(1) states "the Act requires that no person shall sell a Stock Remedy into the Republic unless the container in which it is sold complies with the prescribed requirements and is sealed and labelled in such manner as may be prescribed". Furthermore, Act 36 stipulates the requirements specifically for pictures that appear on pesticide labels of which industries need to comply with.

Additionally, South Africa uses the global recommendation of the Food and Agriculture Organization from the United Nations Guidelines on Good Labelling Practice for Pesticides as a guide for their own pesticide labels (WHO, 2015). According to the FAO guideline section, (4.6 on use of symbols, pictograms and illustrations), the hazard symbols of the GHS as per Appendix 2.2 are applicable to use on both chemicals and pesticides. Based on the mandatory label requirements set out by the Fertilisers, Farm Feeds, Agricultural Remedies and Stock Remedies Act 36 of 1947, one of the reasons pictograms are used by industry for labels, can be largely motivated by compliance to the law rather than seeking to protect people from harm.

Therefore, based on regulations that include sale of pesticides and chemicals in South Africa, a large motivator for industry to include information (labels) on their products is to avoid legal implications should people experience adverse health risks. Rother (2018) argues that often pesticides labels is used to transfer the liability of end-users exposure to hazards of the product off of industry and onto the end-user rather than using labels to function as an effective risk communication vehicle. Another reason for pesticide industries to use labels is driven by economic profits because in order to legally sell their products, they need to adhere to the national legislation.

There is, however, no specific chemical and overarching legislation on chemical labelling in South Africa such as the European Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) or the American Toxic Substances Control Act (TSCA) similar to Israel (Negev *et al.,* 2018). Negev *et al (*2018) noted that due to Israel's lack of an overarching legislation, gaps in adequately regulating chemicals and pesticides emerge. A lack of an overarching chemical legislation in South Africa can be problematic for consumers as it can create confusion about what different pictograms mean and when to apply them. Though the South African Bureau of Standards (SABS) who developed the South African National Standard (SANS 10234-2008-A) states that the classification and labelling of chemicals in South Africa needs to be in accordance with the GHS; however, this needs to be updated as it makes reference to an old version of the GHS handbook and needs to fit the current context of the country (Chemical Pro Safety, 2017).

2.4 Risk perception and how this influences understanding of label information

In Public Health, risk perception refers to the examination of lay people's ability to understand their health- related choices in order to make an informed decision about their health (Fischhoff, 2013). Risk perception requires the understanding of what risks and benefits are associated with health-related decisions (Fischhoff, 2013). The concept of risk perception is essential when examining the extent to which information provided on chemical labels is sufficient in providing end-users with both the benefits and risks associated with the chemical product at hand. According to a study conducted by Barraza *et al* (2011) on risk perception of pesticide use in banana and plantain production in Costa Rica, there were five differences between the perceptions of pesticide risks identified amongst participants, of which three are applicable to the discussion in this paper.

The first factor influencing risk perception found by Barraza *et al* (2011) was that different gender roles had an influence in shaping the knowledge that participants had about pesticides according to the position they were given to work in the labor process. Secondly, Barraza *et al* (2011) identified that the hierarchy of jobs on farms (from high positions to low rank positions

workers generally have a different risk perception for their health). Thirdly, workers infer their personal definitions of what a risk is in their workplace, which in turn, influences their sense of risk perception when engaging in work activities (Barraza *et al* (2011). There are myriad factors that contribute towards influencing risk perception which filters into understandings of chemical labels. In order to study people's ability to comprehend chemical labels and pictograms, it is important to take into account the three aspects of risk perceptions discussed by Barraza *et al* (2011).

2.5 Gaps in the literature.

Firstly, there is a distinct shortage of detailed evidence that shows how risk communication can influence attitudes and behaviours towards risk reduction through use of symbols, when handling and using chemicals in South Africa (Hinks *et al.,* 2009). Therefore, the gap in literature that the study aims to research is the cultural practices and educational attainment that can hinder or promote the comprehensibility of pictograms amongst caregivers in South Africa. Furthermore, this research specifically focuses on the caregiver population group as the research previously done in South Africa has particularly focused on the comprehensibility of chemical labels pertaining to adults. This is important to be researched as this knowledge gap can perpetuate children's exposure causing adverse health risks due to poor chemical handling amongst their caregivers. Through addressing this gap, the research therefore aims to be used to inform policies and awareness raising efforts by government to adopt pictograms that are most likely to be understood by vulnerable groups of society.

Lastly, as the GSH framework is still a relatively new framework that has been adopted in South Africa, there is still a gap in the literature as to its applicability in the context of the country. Context-specific research based on the GHS can contribute towards its successful integration in the chemical market. Furthermore, the GHS is revising the seventh edition with proposed changes that includes the inclusion of a new pictogram to protect children's exposure to chemicals. The GHS plans to add a pictogram to the precautionary statement P102 "Keep out of reach of children" and have several suggestions as seen in Appendix 2.1. Though the changes have been proposed by experts of the GHS task team, it would still need to be researched as to whether it is effective within a South African context.

2.6 Aim

The aim of the study is to assess the comprehension of GHS pictograms among child caregivers in preventing adverse health risks linked to children's exposure to chemicals.

2.7 Main research question

What are the barriers that prevent child caregivers from understanding pictograms as scientifically intended?

2.8 Study Objectives

The objectives to address the study aim are:

1. *To investigate South African caregivers' understanding of existing and newly proposed pictograms on chemical labels.*
2. *To investigate the barriers affecting the comprehension of pictograms amongst South African caregivers.*
3. *To suggest ways in which pictograms on chemical labels can be improved to facilitate comprehension and understanding amongst South African caregivers.*

SECTION THREE: Methodology

3.1 Study design

This study uses a cross-sectional mixed-methods approach by utilising both quantitative and qualitative methods. A mixed method approach was chosen due to the benefits specific to each method, with the aim of richer data being provided through a combination of the two methods. On the one hand, a quantitative approach will provide the researcher with descriptive statistics that can answer the research question. On the other, a qualitative approach will provide the researcher with in-depth responses that are not dichotomous or one-worded and enables participants to provide richer explanations. A qualitative approach will therefore aid in capturing participants' nuanced and varied understandings, as well as why this might be the case. The mixed method approach will be applied to a cross-sectional study design. A cross-sectional study design was chosen as it allows a 'snapshot' of the characteristics associated with an outcome, at one specific time (Levin, 2006). It is therefore, appropriate for the objectives in section 2.8 of the literature review wherein the current knowledge and understanding of participants is of interest.

3.2 Study population and sampling

3.2.1 Study location

Paarl

Paarl is 60km outside of Cape Town and has approximately 103 farms (Nakana & Mkhabela, 2011). According to the 2011 Paarl census, 93, 704 people in Paarl preferred to speak Afrikaans and the largest portion of the population group (compromising of 78,303 residents) were coloured. The coloured racial group in South Africa was previously oppressed during the apartheid regime and still comprises a large proportion of South Africa's vulnerable communities today. Using a farm in Paarl as a study location allows for the assessment of the effectiveness of pictograms within communities exposed to pesticides, which are likely to have a lower educational status (i.e. majority of community members not completing secondary or primary school). Since the focus of this study is on protecting children, only caregivers working on the farms in Paarl will be interviewed.

Childsafe, Rondebosch

The second study location that will be included in this study is Childsafe, a non-governmental organisation (NGO) which focuses on accidental injuries, including poisonings from chemicals, resulting in the hospitalisation of children. ChildSafe is situated on the property of Red Cross Children's War Memorial Hospital in the suburb of Rondebosch in Cape Town. The caregivers who are seen by ChildSafe are referred by RCWCMH as their children have either been poisoned

by chemicals or admitted due to an unintentional injury. As RCWMCH is a referral hospital, the parents come from varying residential areas in and around Cape Town, which include high-density informal settlements and low-density urban areas. ChildSafe is an organisation that focuses on preventing unintentional injuries involving children, such as poisoning from chemicals (ChildSafe, 2019). Therefore, the organisation will be used to gather knowledge and understanding from participants who may or may not have been exposed to the label of the chemical involved in poisoning their child.

University of Cape Town (UCT)

The third study location is UCT, a university situated in Cape Town, Western Cape. Students attending UCT come from diverse backgrounds, have all completed secondary education and are in the process of completing a tertiary degree. The assumption is that university students who are caretakers of children should have a certain level of comprehension and can apply the principle to pictograms on chemical labels, therefore being in a better position to protect their children in comparison to participants from the other study sites. Therefore, as the GHS aims to appeal to people from diverse backgrounds, using South African students who have/are gaining a tertiary degree will be beneficial to the study to compare against the responses of South Africans without higher-education backgrounds.

3.3 Sampling strategy

The study sample population will include participants from a farming community in Paarl, the University of Cape Town, and ChildSafe, respectively. The aforementioned locations were chosen due to their unique characteristics that differentiate them from one another and therefore add value to the data collected. Each location differs by socio-economic group, language spoken and proximity to farms, and all are exposed to pesticides or household chemicals. The participants forming this group will be used to determine whether educational attainment has an influence on comprehensibility of pictograms.

Non-probability sampling will be used, as randomization is not essential for choosing the participants of this study due to the three different locations, which will provide enough diversity for comparison. Within non-probability sampling, purposive sampling and convenience sampling will be used. Purposive sampling will be used for the ChildSafe group and UCT and convenience sampling will be used for the farm on Paarl group. Thirty-five child caregivers will be selected from each study location for a total sample size of 105 participants. This sampling method will be used due to it being time-effective for the purpose of a mini-dissertation study. The proposed time for data collection will be December 2019, which is high season for farmworkers, and therefore data collection can be done within the farm's schedule. Furthermore, non-probability sampling

will be advantageous for the UCT location data collection will occur during the university's holiday wherein a limited amount of students will be present on campus.

3.3.1 Purposive sampling

Purposive sampling, a sub-method of non-probability sampling, allows researchers who are incorporating a qualitative study design to identify information-rich cases in order to get effective data (Etikan, *et al.*, 2016). Purposive sampling will be used at ChildSafe as this NGO works with parents whose children are admitted to RCWCH due to unintentional injury, including poisoning. The researcher will approach parents as they filter into ChildSafe and invite them to complete the questionnaire. Parents whose children suffered an accidental injury are referred by the RCWCH to visit ChildSafe for safety workshops before the child will be discharged. The researcher will, however, inform parents that their participation in the research study is separate to their referral to ChildSafe. An informed consent form (Appendix 1.1 or 1.2) will be given and explained to potential participants once they show interest to participate in the study. The researcher will use an empty room in ChildSafe, to conduct this research. Permission to use Childsafe as a location will be given by the medical manager at RCWMCH and by the Director of the organisation.

Purposive sampling will be used at the University of Cape Town where students in the Faculty of Health Sciences will be approached by the researcher, asked if they have children and be invited to the study. The University of Cape Town was chosen due to collecting information specifically from a group of people who are completing their tertiary education. The researcher will approach all students walking into a common area (cafeteria) on the Health Sciences campus and ask them if they have child. The first 35 students who meet the criteria will be invited to participate in the study. The consent form will be explained, and the purpose of the study will be presented, and once they agree and consent has been provided, an isolated section in the cafeteria will be used for the researcher to administer the questionnaires to the students to complete. The researcher will capture the respondents' answers using a secure online platform, CommCare.

3.3.2 Convenience sampling

In the Paarl area, the primary researcher will decide at random which shift (early or late shift) will be used each day to approach the prospective participants. Convenience sampling will be used for the Paarl location as individuals who will be invited to partake in the study are from the target population that meet the research inclusion criteria. This is based on practicality such as easy accessibility, geographical proximity and their willingness to participate in the study (Etikan, Musa & Alkassim, 2016). Convenience sampling will be implemented furthermore, as a key

worker from the farm will help identify possible participants who will be available to be interviewed. This is necessary due to the context of the farmworkers' schedule during the proposed data collection time (packing season) where the workers will be in the storage unit, which is a restricted area that cannot be accessed by the researcher. Additionally, due to the time pressure of their work, the workers can only be interviewed during their lunch break or after work. The key farm worker will therefore approach workers before their shift in the morning and if the workers are willing, inform the researcher to approach the identified workers during their lunch or after work. The research will explain the consent form and the purpose of the study to the farmworkers and they will be given the opportunity to not participate or agree to participate. Once the farmworkers have agreed, they will be given a time to meet the researcher (30 minute slots will be made). The participants will be individually interviewed in a private room situated on the farm that has been allocated by the operations manager for the interviews. Furthermore, the researcher will be given an indication by the key farm member of a section where there are houses with residents that no longer work but reside on the premises. The researcher will walk through the houses and approach residents who are at their homes and if they are willing to participate, include them in the study.

3.4 Data collection (Appendix 3/4 /11)

Data collection will take place within the ***last week of February 2020 and the first week of March 2020.*** In the first week of February, data collection will take place at the Paarl and UCT locations. Following into the next week, data collection will be conducted at Child Safe. Each location will be allocated three and a half days of data collection respectively.

The data will be collected using a questionnaire (Appendix 3/4) that will be electronically loaded onto the CommCare application and accessed on the researcher's laptop/mobile device. Questions will be asked face-to-face for all respondents by the primary researcher. A face-to-face questionnaire is beneficial to use in health service research as it assists in collecting data in a manner that is efficient and effective, allowing the researcher to overcome literacy barriers (O'Cathain & Thomas, 2004). A questionnaire is advantageous as it can consist of both open and close ended questions in order to accommodate mixed method approaches (O'Cathain & Thomas 2004). The questionnaires will be both in English and Afrikaans at all the locations. Due to the time and financial constraints in conducting the research, the questionnaire will not be translated into any of the other 11 languages. Participants however, will still be approached according to the sampling strategy (and not excluded in the process) and can select their language of choice, English or Afrikaans. The informed consent form and interview will be conducted in the language chosen by the participants. As the primary researcher first language is English and second language Afrikaans, the primary researcher will conduct all the face-to-face interviews in either language chosen.

The questions that will be asked will be derived from the objectives of the study. With reference to appendix three, four and eleven, questions one to seven will consist of the demographic data and are close- ended questions. In appendix three, questions ten and eleven are open-ended questions, as it requires personal opinions from the participants. Furthermore, participants will receive a laminated sheet (appendix 2.1, 2.2, 8) that will be referred to in question nine in the questionnaire (in appendix 3).

3.5 Data management

The researcher will have an electronic copy of the questionnaire on a secured application called CommCare HQ that will be on the researcher's private phone. Both the application and cellular phone are password-protected. Only the primary researcher will have access to the information after the data is collected and it will only be used for the purpose of this study. The process of the self-administration questionnaire and the security of the application will be explained to the participants. The researcher will upload the questionnaire onto CommCare HQ by signing into the website with a personalized username and password. Each time a participant is interviewed the researcher will sign into the CommCare HQ account and complete the questionnaire that has been uploaded for the study.

For the qualitative section of the questionnaire, as the respondents answer the open-ended questions, the researcher will type the responses as the respondent speaks, without changing the wording or paraphrasing what is being said, onto an electronic version of the questionnaire on CommCare Hq. Due to the nature of the data collection being a face-to- face questionnaire and not an interview, the researcher will not probe on open-ended questions or use any interviewer skills to elicit further information, therefore the method used to capture the responses will not result in loss of data. Furthermore, The transference of the questionnaire to Excel will not affect the format of the answers provided. Similarly, the same process will be used to collect the quantitative section of the questionnaire. Once all data has been collected on the website CommCare Hq, it will be transferred onto an excel sheet which is a function provided by the website.

3.6 Sub-methodology due to global COVID-19 outbreak

Due to the outbreak of COVID-19 globally, and particularly the increased cases in the Western Cape, South Africa, the South African government has implemented strict restrictions that include the suspension of academic activities. In response, the Human Ethics Research Committee recommended that all non-therapeutic research involving Human Participants be stopped from the date of the announcement on the 17 March 2020. Therefore, as the nature of this study is non-therapeutic and involving face-to-face interviews with vulnerable groups of society, the data collection method will be changed.

Up until the date of the suspension of university activities, the researcher interviewed twenty-one participants following the original data collection methods. Two of the participants are from the University of Cape Town, two participants are from Childsafe at Red Cross War Memorial Hospital and seventeen are from the farm in Paarl. The data collected from the twenty-one participants will not be discarded, as the research study is a mixed method that includes qualitative methods where analysis can be made from responses. Therefore, the data will still be included. In the event that the COVID-19 restrictions are lifted and fall within the research study time frame, the researcher will continue to collect data from the participants at Childsafe and the farm in Paarl. The study design will therefore remain the same, however, changes to the location, sampling strategy and data collection tool will be made to accommodate the continuation of the process during COVID-19.

3.6.1 Study location during COVID-19 pandemic

In order to continue the data collection process during the COVID-19 restriction period, the existing study location, the University of Cape Town, was chosen to distribute an online questionnaire. The study location was chosen, as students are not likely to have literacy barriers and furthermore, are assumed to have frequent access to an Internet connection and a computer, to complete the online questionnaire. The online questionnaire will be released concurrently when the University of Cape Town begins the online learning process for students in the week of the 27th of April 2020. Therefore students will have received mitigation resources to continue their academic work, such as data to access internet and a laptop/electronic device.

3.6.2 Data collection tool

The researcher will use an online questionnaire as the data collection tool. The existing questionnaire used for the face-to-face interviews will be downloaded on the online platform, Google forms. In order to transform the questionnaire from a face-to-face orientated questionnaire to an online questionnaire, sentence structure will be changed from the original questionnaire (Appendix 3) and adapted to an online questionnaire style (Appendix 11). The online questionnaire will not be translated into Afrikaans due to the location chosen where majority of the students are enrolled in a predominantly English university.

Additionally, the Google form will be generated on the researcher's private Gmail account that is protected by a password and that only the researcher will have access to. Google forms was chosen as a platform as the information collected can be saved into an Excel sheet which is similar to the initial questionnaires platform, CommcareHQ.

3.6.3 Sampling strategy during COVID-19 pandemic

The sampling strategy that will be used for the online questionnaire is purposive sampling. The Department of Student Affairs at the University of Cape Town will be approached as they provide a service of sending out research invitations to students at the university. The potential participants will need to fit the criteria of having a child, while being enrolled as a student at the university. The researcher will request a cut-off date for the students to complete the online questionnaire. The original sample size for the location will be increased to sixty students. Increasing the sample size from 35 to 60 students was selected to account for the loss of participants (35 participants) who would have been recruited from RCWMCH in the initial protocol. However, should 60 participants not complete the questionnaire within the given time nor fit the eligibility criteria (being a caregiver to a child under 18 years of age), the sample size will be reduced to the amount of eligible participants.

3.7 Data analysis for whole research study

The quantitative data will be analysed using the data analysis platform RStudio. The data will be exported from the Excel document from both CommCare and Google Forms to RStudio by the researcher. As the researcher is bilingual and can speak Afrikaans, the researcher will translate the questionnaires answered in Afrikaans, to English. Once the data has been transferred to Rstudio, the effects of different demographic variables such as age, sex, educational status and socio-economic status with comprehension of the existing and new pictograms will be analysed using cross Tables. Furthermore, a chi-square test will be used to test whether there is a significant association between each variable in the study and a participant's ability to comprehend a pictogram. A multivariate analysis will be conducted to test whether the level of education and cultural practices has an effect on a participant's chemical safety behaviour. Furthermore, the Chi-square test will be used to test whether there is a significant association between the baseline variables. Education and socio-economic status are hypothesised to be barriers towards comprehensibility.

For the qualitative data collected, the data will be analysed verbatim according to a codebook analysis. Coding is the process of identifying data related to the research question (Braun & Clarke, 2013). Once coding has been completed, larger patterns will be identified across the dataset in order to create themes relevant to the research question (Braun & Clarke, 2013). In the codebook, the open-ended questions from the questionnaires will therefore be analysed using themes that will be derived from the social theory, cultural capital and the semiotics theory, as well as symbolism and meaning. The researcher will identify patterns by grouping the same words and explanations used by the various participants' questionnaires. After all the data has been analysed and extracted, tables, histograms and pie charts will be used to illustrate quantitative and qualitative data.

3.8 Logistics and time schedule

	January 2020	February 2020	March 2020	April 2020	May 2020	June 2020	July 2020	August 2020	September 2020
Proposal submission to Ethics									
Data collection									
Data entry and analysis									
Final journal article to be submitted									
First draft full thesis									
Final draft of thesis and Turnitin report and submission									

3.9 Limitations

One limitation of this research study is that the questionnaire only makes provision for two of the eleven official languages of South Africa. Therefore, a prospective participant may decline to participate if they are unable to speak Afrikaans or English. This would result in less population variation and a decreased ability to generalise the study's findings. Secondly, the study is geographically limited, as it will only be conducted within the Western Cape province. This limits a national representation in the sample size as it only includes one province's residents out of the nine provinces of South Africa. This could hinder the generalizability of the study results. Thirdly, the use of a non-random sample strategy could lead to a bias in relation to the selection of the participants (Etikan, Musa & Alkassim, 2016). In order to reduce this bias in the Paarl study location, the researcher will ask the key farm worker helping to identify participants, to approach a variety of people who different from age, gender and job description. From Child Safe, the researcher will interview the first thirty-five willing participants who are referred to the Child Safe organisation at

RCWMH. Lastly at UCT, similarly, the first thirty-five willing participants who fit the inclusion criteria will be included in the study based on their availability and convenience.

The final limitation of the study is that the initial data collection process with face-to-face questionnaires could not continue due to the global pandemic, COVID-19 at the time of data collection. Therefore in order to continue the data collection process, the data collection tool will need to be adapted to an online questionnaire. This therefore will require changes to the initial data collection tool used to be online-friendly. Furthermore, online questionnaires are limited to a particular audience who has internet access, electronic device access and the researcher's access to information (email addresses) of potential participants in Paarl and Red Cross War Memorial Children's hospital, the two initial locations. This therefore limited the study to collecting data in only one study location.

3.10 Pilot

The pilot will be conducted once ethical approval from HREC at the University of Cape Town is received (Appendix 13). The pilot will include the primary researcher self-administering the study questionnaire to five pilot participants. The researcher will use the convenience sampling method as per the methodology section whereby the researcher will approach five potential participants at the location of Paarl farm. The purpose of both the study and pilot will be explained to the potential participants and they will be given consent forms should they agree to be a part of the pilot.

3.11 Ethical considerations

3.10.1 Voluntary informed consent (Appendix 1.1/1.2)

Voluntary informed consent refers to the participants providing written/verbal consent to participate in the research study based on being fully aware of the procedures that the study will have and without any external influence or pressure (Sims and Miracle 2002). The informed consent forms in appendix one will be given to the participants in hard copy format, providing information about the full procedure that the study will undertake. The consent form will be read to participants being interviewed face-to-face in their language of choice and signed by participants if they are happy to participate in the study. It will be clarified to all participants that the study is confidential, and that only the researcher and supervisor will access the data. It will also be made clear to the participants that they can withdraw at any time during the study. There will be two copies of signed consent forms and one will be given to the participant to keep. The research proposal will be submitted to the University of Cape Town's Research Ethics Committee.

For the online questionnaire, the same informed consent form (appendix 1) used for the face-to-face interviews was converted to an online consent form (appendix 1.3), was used, with minor changes to reflect words relevant for an online questionnaire (appendix 1.3). The informed consent form will be

included in the beginning of Google Form/online questionnaire where they are required to read the consent form. Once participants have read the informed consent form, they will be provided with three options; "I understand the information provided in the informed consent form about participating in this questionnaire, "I agree to participate in this study" and "I do not agree to participate in this study (submit form by section 4)". The online questionnaire will automatically end if the participant chooses the option to not participate in the study.

3.10.2 Privacy and confidentiality

Privacy and confidentiality will be maintained throughout the research study. The student and supervisor will be the only people who have access to the completed questionnaires. The names and identity of the participants will not be revealed under any circumstance and will not be used within the mini-dissertation. The name of the farm in Paarl will remain anonymous, as requested by the operations manager.

3.10.3 Potential risks

There is no physical or emotional harm that is affiliated with participation in this study as it only employs the use of a questionnaire. There is a potential risk that after being made aware of the chemical labels and their potential risks as a result of completing the questionnaire, that participants may feel confused or unclear about chemical safety behaviour and concerned about future or past exposures. Participants will be provided with information on how to read a label and what the pictograms mean after completing the questionnaire, as displayed in appendix five and six, in both English and Afrikaans. Participants who remain concerned will be encouraged to contact Child Safe and the local Environmental Health Practitioner for more information.

3.10.4 Permission to conduct research at locations

For Child Safe, permission to conduct the research at the organisation will be gained by the researcher by approaching the director of the organisation to request permission from the individual employed as the research co-ordinator head. Approval at UCT will be requested by completing a DSA 100 form to gain permission to interview students, which will be submitted to the university.

References

Andrade-Rivas, F., & Rother, H. A. (2015). Chemical exposure reduction: Factors impacting on South African herbicide sprayers' personal protective equipment compliance and high risk work practices. *Environmental research*, *142*, 34-45.

Airhihenbuwa, C. O., & Webster, J. D. (2004). Culture and African contexts of HIV/AIDS prevention, care and support. *Sahara-J: Journal of Social Aspects of HIV/AIDS*, *1*(1), 4-13.

Ajzen, I., 2011. The theory of planned behaviour: Reactions and reflections.

Balme, K.H., Roberts, J.C., Glasstone, M., Curling, L., Rother, H.A., London, L., Zar, H. and Mann, M.D., 2010. Pesticide poisonings at a tertiary children's hospital in South Africa: an increasing problem. *Clinical Toxicology*, *48*(9), pp.928-934.

Balme, K., Roberts, J. C., Glasstone, M., Curling, L., & Mann, M. D. (2012). The changing trends of childhood poisoning at a tertiary children's hospital in South Africa. *South African Medical Journal,* 102(3).

Banda, S. F., & Sichilongo, K. (2006). Analysis of the level of comprehension of chemical hazard labels: a case for Zambia. *Science of the total Environment*, *363*(1-3), 22-27.

Barraza, D., Jansen, K., de Joode, B. V. W., & Wesseling, C. (2011). Pesticide use in banana and plantain production and risk perception among local actors in Talamanca, Costa Rica. *Environmental research*, 111(5), 708-717.

Barros, I. M., Alcântara, T. S., Mesquita, A. R., Santos, A. C. O., Paixão, F. P., & Lyra Jr, D. P. (2014). The use of pictograms in the health care: a literature review. Research in Social and Administrative Pharmacy, 10(5), 704-719.

Bellinger, D. C. (2013). Prenatal exposures to environmental chemicals and children's neurodevelopment: an update. *Safety and health at work*, *4*(1), 1-11.

Bennin, F. and Rother, H.A., 2015. "But it's just paracetamol": Caregivers' ability to administer over-the-counter painkillers to children with the information provided. *Patient education and counseling*, *98*(3), pp.331-337.

Beaufils, E., Hommet, C., Brault, F., Marqué, A., Eudo, C., Vierron, E., De Toffol, B., Constans, T. and Mondon, K., 2014. The effect of age and educational level on the cognitive processes used to comprehend the meaning of pictograms. *Aging clinical and experimental research*, *26*(1), pp.61-65.

Bouchard, M. F., Chevrier, J., Harley, K. G., Kogut, K., Vedar, M., Calderon, N., ... & Eskenazi, B. (2011). Prenatal exposure to organophosphate pesticides and IQ in 7-year-old children. *Environmental health perspectives*, *119*(8), 1189-1195.

Boelhouwer, E., Davis, J., Franco-Watkins, A., Dorris, N., & Lungu, C. (2013). Comprehension of hazard communication: effects of pictograms on safety data sheets and labels. *Journal of safety research*, *46*, 145-155.

Braun, V., & Clarke, V. (2013). *Successful qualitative research: A practical guide for beginners*. sage.

Cigularov, K.P., Chen, P.Y. and Stallones, L., 2009. Error communication in young farm workers: Its relationship to safety climate and safety locus of control. *Work & Stress*, *23*(4), pp.297-312.

Chendrashekaran, P. (2017). A Cross-Sectional Survey on the Awareness of Pesticide Labels and Pesticide Safety Pictograms among Paddy Farming In South India. *Journal of health sciences and surveillance system*, *4*(4), 158-166.

Childsafe (2019). Retrieved June 11, 2019,from: https://www.childsafe.org.za.

Chemical Pro Safety. GHS in South Africa. Available: https://www.chemsafetypro.com/Topics/South_Africa/GHS_in_South_Africa.html [2020, February 15].

American Academy of Pediatrics Council on Environmental Health, 2012. Pesticide Exposure in Children. *American Academy of Pediatrics, 130 (6) e1757-e1763;*

Dowse, R. and Ehlers, M.S., 2001. The evaluation of pharmaceutical pictograms in a low-literate South African population. *Patient education and counseling*, *45*(2), pp.87-99.

Dalvie, M. A., Rother, H. A., & London, L. (2014). Chemical hazard communication comprehensibility in South Africa: Safety implications for the adoption of the globally harmonised system of classification and labelling of chemicals. Safety science, 61, 51-58.

Dionisio, K.L., Frame, A.M., Goldsmith, M.R., Wambaugh, J.F., Liddell, A., Cathey, T., Smith, D., Vail, J., Ernstoff, A.S., Fantke, P. and Jolliet, O., 2015. Exploring consumer exposure pathways and patterns of use for chemicals in the environment. Toxicology reports, 2, pp.228-237.

Ehlers, M. and Dowse, R., 2004. Pictograms for conveying medicine instructions: comprehension in various South African language groups. *South African Journal of Science,* 100(11), pp.687-693.

Emery, S. B., Hart, A., Butler-Ellis, C., Gerritsen-Ebben, M. G., Machera, K., Spanoghe, P., & Frewer, L. J. (2015). A review of the use of pictograms for communicating pesticide hazards and safety instructions: implications for EU policy. *Human and Ecological Risk Assessment: An International Journal*, *21*(4), 1062-1080.

Etikan, I., Musa, S. A., & Alkassim, R. S. (2016). Comparison of convenience sampling and purposive sampling. *American journal of theoretical and applied statistics*, *5*(1), 1-4.

Fischhoff, B. (2013). Risk perception and communication. In *Risk Analysis and Human Behavior* (pp. 17-46). Routledge.

Edworthy, J., Hellier, E., Morley, N., Grey, C., Aldrich, K. and Lee, A., 2004. Linguistic and location effects in compliance with pesticide warning labels for amateur and professional users. *Human factors*, *46*(1), pp.11-31.

Montagne, M., 2013. Pharmaceutical pictograms: a model for development and testing for comprehension and utility. *Research in Social and Administrative Pharmacy*, *9*(5), pp.609-620.

Gaber, S., & Abdel-Latif, S. H. (2012). Effect of education and health locus of control on safe use of pesticides: a cross sectional random study. *Journal of Occupational Medicine and Toxicology*, *7*(1), 3.

Gilden, R.C., Huffling, K. and Sattler, B., 2010. Pesticides and health risks. *Journal of Obstetric, Gynecologic & Neonatal Nursing*, *39*(1), pp.103-110.

Hassan, E.M.M., 2015. The semiotics of pictogram in the Signage Systems. *International Design Journal*, *5*(2), pp.301-315.

Hancock, D. B., Martin, E. R., Mayhew, G. M., Stajich, J. M., Jewett, R., Stacy, M. A, Scott B. L., Vance, J.M & Scott, W. K. (2008). Pesticide exposure and risk of Parkinson's disease: a family-based case-control study. *BMC neurology*, *8*(1), 6.

Hara, K., Mori, M., Ishitake, T., Kitajima, H., Sakai, K., Nakaaki, K. and Jonai, H., 2007. Results of recognition tests on Japanese subjects of the labels presently used in Japan and the UN-GHS labels. *Journal of occupational health*, *49*(4), pp.260-267.

Hinks, J., Bush, J., Andras, P., Garratt, J., Pigott, G., Kennedy, A., & Pless-Mulloli, T. (2009). Views on chemical safety information and influences on chemical disposal behaviour in the UK. *Science of the total environment*, *407*(4), 1299-1306.

Korenevsky, A., Vaillancourt, R., Pouliot, A., Revol, M., Steed, E., Besançon, L., ... & Patel, J. R. (2013). How many words does a picture really tell? Cross-sectional descriptive study of pictogram evaluation by youth. *The Canadian Journal of Hospital Pharmacy*, *66*(4), 219.

Landrigan, P. J., & Etzel, R. A. (Eds.). (2013). *Textbook of children's environmental health*. Oxford University Press.

Laughery, K. R., & Wogalter, M. S. (2014). A three-stage model summarizes product warning and environmental sign research. *Safety science*, *61*, 3-10.

Levin, K. A. (2006). Study design III: Cross-sectional studies. *Evidence-based dentistry*, *7*(1), 24-25.

Lesch, M.F., Horrey, W.J., Wogalter, M.S. and Powell, W.R., 2011. Age-related differences in warning symbol comprehension and training effectiveness: effects of familiarity, complexity, and comprehensibility. Ergonomics, 54(10), pp.879-890.

Liu, Y.C. and Ho, C.H., 2012. The effects of age on symbol comprehension in central rail hubs in Taiwan. *Applied ergonomics*, *43*(6), pp.1016-1025.

Mayer, B., Flocks, J. and Monaghan, P., 2010. The role of employers and supervisors in promoting pesticide safety behavior among Florida farmworkers. *American Journal of Industrial Medicine*, *53*(8), pp.814-824.

Montes-Grajales, D., Fennix-Agudelo, M., & Miranda-Castro, W. (2017). Occurrence of personal care products as emerging chemicals of concern in water resources: A review. Science of the Total Environment, 595, 601-614.

Nakana, E., & Mkhabela, T. (2011). Performance determinants of wine farms in the Western Cape: An interval modelling approach. *Agrekon*, *50*(1), 53-70.

Naidoo, S., London, L., Rother, H. A., Burdorf, A., Naidoo, R. N., & Kromhout, H. (2010). Pesticide safety training and practices in women working in small-scale agriculture in South Africa. Occupational and environmental medicine, oem-2010.

Negev, M., Berman, T., Reicher, S., Balan, S., Soehl, A., Goulden, S., Ardi, R., Shammai, Y., Hadar, L., Blum, A. and Diamond, M.L., 2018. Regulation of chemicals in children's products: How US and EU regulation impacts small markets. *Science of the Total Environment*, *616*, pp.462-471.

O'Cathain, A., & Thomas, K. J. (2004). " Any other comments?" Open questions on questionnaires–a bane or a bonus to research?. *BMC medical research methodology*, *4*(1), 25.

Pinxten, W. and Lievens, J., 2014. The importance of economic, social and cultural capital in understanding health inequalities: using a Bourdieu-based approach in research on physical and mental health perceptions. *Sociology of health & illness*, *36*(7), pp.1095-1110.

Paarl – Census. (2011). Retrieved June 11, 2019,from: https://census2011.adrianfrith.com/place/166008

Poojari, P. G., Thunga, G., Nair, S., Kunhikatta, V., & Rao, M. (2019). A global overview of poison treatment apps and databases. *International journal of toxicology*, *38*(2), 146-153.

Quinn, L. P., Fernandes-Whaley, M., Roos, C., Bouwman, H., Kylin, H., Pieters, R., & Van Den Berg, J. (2011). Pesticide use in South Africa: one of the largest importers of pesticides in Africa. In *Pesticides in the Modern World-Pesticides Use and Management*. InTech.

Reid, A., Callan, A., Stasinska, A., Heyworth, J., Phi, D.T., Odland, J.O. and Hinwood, A., 2013. Maternal exposure to organochlorine pesticides in Western Australia. *Science of The Total Environment*, *449*, pp.208-213.

Rother, H. A. (2008). South African farm workers' interpretation of risk assessment data expressed as pictograms on pesticide labels. *Environmental research*, *108*(3), 419-427.

Rother, H.A (2014). Communicating pesticide neurotoxicity research findings and risks to decision-makers and the public. *NeuroToxicology 45* (2014) 327–337

Rother, H.A., 2016. Pesticide vendors in the informal sector: trading health for income. *New Solutions: A Journal of Environmental and Occupational Health Policy*, *26*(2), pp.241-252.

Rother, H. A. (2018). Pesticide Labels: Protecting Liability or Health?–Unpacking "misuse" of pesticides. *Current Opinion in Environmental Science & Health , 4, 10-15.*

Sathar, F., Dalvie, M. A., Rother, H. A., & London, L. (2017). Demographic determinants of chemical safety information recall in workers and consumers in South Africa: A cross sectional study. Journal of safety research, 63, 61-71.

Sathar, F., Dalvie, M. A., & Rother, H. A. (2016). Review of the literature on determinants of chemical hazard information recall among workers and consumers. International journal of environmental research and public health, 13(6), 546.

Schwebel, D. C., Evans, W. D., Hoeffler, S. E., Marlenga, B. L., Nguyen, S. P., Jovanov, E., ... & Sheares, B. J. (2017). Unintentional child poisoning risk: A review of causal factors and prevention studies. Children's health care, 46(2), 109-130.

Sharp, J. H. (2011). Semiotics as a theoretical foundation of information design. *Proceedings of the CONISAR*, 4, 1-5

Sly, P. D., & Flack, F. (2008). Susceptibility of children to environmental pollutants. *Annals of the New York Academy of Sciences*, *1140*(1), 163-18

Sosan, M. B., & Akingbohungbe, A. E. (2009). Occupational insecticide exposure and perception of safety measures among cacao farmers in Southwestern Nigeria. *Archives of environmental & occupational health*, *64*(3), 185-193.

Sims, J. and Miracle, V.A., 2002. Elements of an informed consent. *Dimensions of Critical Care Nursing*, *21*(6), pp.242-245.

Scheer, D., Benighaus, C., Benighaus, L., Renn, O., Gold, S., Röder, B., & Böl, G. F. (2014). The distinction between risk and hazard: understanding and use in stakeholder communication. *Risk Analysis*, *34*(7), 1270-1285.

Sullivan, A. (2002). Bourdieu and education: How useful is Bourdieu's theory for researchers?. Netherlands Journal of Social Sciences, 38(2), 144-166.

Tijus, C., Barcenilla, J., De Lavalette, B. C., & Meunier, J. G. (2007). The design, understanding and usage of pictograms. In *Written documents in the workplace* (pp. 17-31). Brill.

United Nations. Economic Commission for Europe. Secretariat. (2019). Globally Harmonized System of Classification and Labelling of Chemicals (GHS). United Nations Publications.

Waichman, A.V., Eve, E. and da Silva Nina, N.C., 2007. Do farmers understand the information displayed on pesticide product labels? A key question to reduce pesticides exposure and risk of poisoning in the Brazilian Amazon. *Crop Protection*, *26*(4), pp.576-583.

West, D. M. (2015). Digital divide: Improving Internet access in the developing world through affordable services and diverse content. *Brookings Institution*.

Winder, C., Azzi, R. and Wagner, D., 2005. The development of the globally harmonized system (GHS) of classification and labelling of hazardous chemicals. *Journal of hazardous materials*, *125*(1-3), pp.29-44.

Westaway, M. S. (2006). A longitudinal investigation of satisfaction with personal and environmental quality of life in an informal South African housing settlement, Doornkop, Soweto. Habitat International, 30(1), 175-189.

World Health Organization, 2015. International Code of Conduct on Pesticide Management Guidelines on Good Labelling Practice for Pesticides

Yakin, H.S.M. and Totu, A., 2014. The semiotic perspectives of Peirce and Saussure: A brief comparative study. *Procedia-Social and Behavioral Sciences*, *155*, pp.4-8.

PART B JOURNAL MANUSCRIPT

Journal Name: Environmental Research Journal

Title*: Analysing the effectiveness of pictograms as a hazard communication mechanism to reduce child exposure risks to chemicals in South Africa*

Author: Tatum Louw and Hanna-Andrea Rother
Environmental Health Division
School of Public Health and Family Medicine
University of Cape Town,
Anzio Road, Observatory,
7925 Cape Town, South Africa

Corresponding author: Hanna-Andrea Rother andrea.rother@uct.ac.za

Abstract

A key public health concern for South African children is their exposure to harmful household chemicals and pesticides, and the potential for short and long-term health effects. As caregivers are the legal guardians of children, they are responsible for their overall well-being and responsible to protect children from hazardous chemical exposures. Therefore, in order to protect their children, it is imperative that they need to have a basic understanding of chemical risks. To understand if South African caregivers' could follow instructions on chemical labels, we focused on analysing their comprehensibility of the chemical hazard communication elements on pesticide labels, namely, pictograms. The aim of the study was to understand the key barriers preventing caregiver's comprehensibility of chemical label pictograms and to highlight recommendations for improvement. A mixed method cross-sectional study design was used with child caregivers from a Western Cape farm and University of Cape Town students (N=46). Data collection utilized a face-to-face administered questionnaire with farmworkers (n=17) and an online questionnaire with student (n=29). The inclusion criteria for both cohorts was that they were caregivers of children. Based on the study results, education, age and cultural aspects (belief) influenced caregiver's perceptions of the dangers for children associated with chemical products. An interesting finding was that students preferred more in depth words on labelling to better communicate information whereas farmworkers preferred clearer pictograms. It is recommended that bottom-up approach be taken into account when designing chemical labels. Chemical label legislation should take into account research findings that focused on the different social and environmental exposures of end-users.

Key words: Pictograms, Comprehensibility, Hazard Communication, Children, and Pesticides

1. Introduction

Effective hazard communication on chemical labels (including pesticides) is essential to safeguard all people from the adverse health risks they can experience when exposed to chemicals. The health dangers that are posed by humans' exposure to chemicals are a global public health issue, especially when considering the multiple exposure routes that exist (WHO, 2016). Although chemical poisoning is a global challenge, the health risks associated with poisoning are even more concerning in low and middle-income countries (LMICs), such as South Africa. The burden of chemical poisoning in LMICs is concerning because of the impact it has on vulnerable groups within societies such as farmworkers, children, lower-socio economic groups and residents of informal settlements (Tolosana *et al.,* 2009; Dalvie *et al.*, 2009, Andrade-Rivas and Rother, 2015). Therefore, the focus of this research was to highlight how to reduce chemical poisoning amongst children in South Africa by investigating the effectiveness of chemical hazard and risk communication mechanisms amongst different groups of caregivers.

Rother (2008) argues that a contributing factor towards human exposure to chemical products is the misinterpretation of risk communication information that can be found on chemical labels. Despite there being information about chemical hazards on chemical labels, it should not be assumed that it is information relevant for the end-user to enact safety behaviours. Research shows that there is a need for label hazard communication mechanisms to be improved in order to increase end-users' comprehensibility thereof (Dalvie *et al.,* 2014). This can be achieved through communicating hazardous chemical information to all population groups in a way that considers diversity of cultures and living circumstances of different countries. The chemical industry, together with international (e.g.,, Globally Harmonized System of Classification and Labelling of Chemicals (GHS) and national chemical regulations is thus responsible in ensuring that hazard communication mechanisms are comprehensible (Winder *et al.,* 2005). The importance of effective and comprehensible chemical label information should be emphasised, as the repercussions of risky chemical practices extend beyond adults and onto children. Children form one of the vulnerable groups that should be focused on in order to decrease their chemical exposure risk and increase their quality of life.

Throughout recent years, more and more research has been conducted on the association between toxic chemicals (including pesticides), and organ or body system impairments and diseases in children (Landrigan and Goldman, 2011; Zeliger, 2013; Sabarwal *et al.,* 2018, Adeyonu *et al* 2019). Health effects amongst children exposed to toxic chemicals that are highlighted in literature include, but are not limited to, asthma, Attention Deficit Hyperactivity Disorder (ADHD), Autism and Central Nervous System Disorders (Landrigan and Goldman, 2011; Zeliger, 2013), Therefore, as children form a large part of society (approximately 35% of South Africa's total population), and have a longer life span, good health is critical to enhance their

quality of life (Hall and Sambu, 2018). A WHO–UNICEF–Lancet Commission on children's future argues that investing early in the health of children, in their education, and ultimately into their development produces benefits that are apparent throughout the lifetime of the child and is imperative for their future (Clark *et al.,* 2020). Therefore, it is vital that there is an increased effort made to ensure that risk information is improved to allow for comprehension in different groups in society.

Of interest in this research, is that children face a double burden of disease by being at risk of prenatal exposure to chemicals, as well as being at risk of exposure throughout their childhood if their caregivers are unable to ensure safe environments (e.g., by practicing appropriate chemical storage and disposal) (WHO, 2019). A study following pregnant women in Denmark who were occupationally exposed to pesticides found that exposure during the women's early pregnancy had a negative association with children's pre-natal and post-natal growth (Wohlfahrt-Vejel *et al.,* 2011). Similarly, a study amongst children who had high prenatal exposure to organophosphate pesticides in the United States of America (USA) found a significant association between prenatal exposure and brain abnormalities (Rauh *et al.,* 2012). Therefore, as a result of prenatal chronic pesticide exposure, children are at risk of disadvantageous birth outcomes, being born with anomalies, at greater risk of developing paediatric cancers, as well as cognitive and neurobehavioral deficits (American Academy of Pediatrics Council on Environmental Health, 2012). Additionally, studies conducted in LMICs like South Africa found associations of negative health outcomes (such as low body weight, poor reproductive health amongst boys, atopic dermatitis) amongst children who had environmental and household exposure to pesticides (Coker *et al.,* 2018, English, 2011, Tolosana *et al.,* 2009). What is concerning is not only that children in LMICs are at risk of pre-natal chemical exposure, but also are potentially at risk of continued chemical exposures throughout their lifespan in their daily life.

Children's bodies are developing both physically and socially and they are playful and explorative by nature, which in return makes them vulnerable to being exposed to hazardous chemicals (Landrigan and Goldman, 2011). As a result of acute exposure to some of the household pesticides, such as insecticides, children are at risk of a magnitude of adverse health impairments such as muscle weakness and respiratory symptoms, (American Academy of Pediatrics Council on Environmental Health, 2012). Due to the magnitude of children's health risks from chemical exposure at an early stage in their lives, there is a need amongst caregivers to facilitate risk reducing behaviour change when handling chemicals, which can then be taught to their children.

In order for caregivers to safeguard their children from exposure to chemical products and to decrease the risk of poisoning, they need to have access to adequate hazard communication

information. Chemical industries and governmental policies, therefore, attempt to mitigate the risk of exposure to harmful chemicals by providing and enforcing appropriate labelling on products. Often the main source of information on the risk, health effects and safety precautions related to chemicals products are found on the label (Rother, 2018). This research focuses on South Africa, a LMIC that is diverse in culture, language and still faces persisting inequalities of the past, such as access to quality information. Therefore, it is imperative that chemical labels meet the needs of all South Africans, especially for groups of people where literacy barriers are present.

A mechanism that is used on pesticide labels to convey information for people who cannot read is pictograms. According to Boelhouwer (2013), visual representation such as pictograms can increase the awareness of the user's risk and provides a trigger of the risk each time it is seen. Studies indicate that the usage of graphical representations on labels and packaging has a larger positive impact by being more appealing than words or phrases (Viswanathan *et al*, 2009, Carrillo *et al* 2014). According to a study amongst patients with Dyspepsia in Belgium, the researchers concluded that when pictograms accompanied verbal descriptions, it improved patients' concordance of rating the symptoms of functional Dyspepsia with their physician's evaluation (Tack *et al.,* 2014). Similarly, a study of pictograms on medication among low-literate patients in Qatar found that simplistic pictograms that were supported with verbal instructions were understood more than the combination of written and verbal instructions or labels that only had pictograms on them (Kheir *et al.,* 2014). A literature review conducted on pictograms in healthcare included 24 studies (half of the studies was done in Africa) and concluded that pictograms were effective for educating patients. However, on the other hand, when pictograms are used outside of the medical context, such as those in the GHS used on chemicals, more comprehension challenges are reported. A study conducted amongst South African farmworkers found that more than 50% of participants in the study had misinformed, incorrect and confused interpretations of what pictograms on pesticide labels were scientifically intended to communicate (Rother, 2008). Similarly, a study investigating Italian farmworkers' interpretation of pictograms on agricultural machines, found that none of the participants in study had the correct interpretation of all pictograms (Vigoroso *et al.,* 2019). Sathar *et al* (2017) argue that as hazard information is often intended for a particular target group*,* it can lead to incorrect interpretations because of cross-cultural differences.

Although pictograms have a range of benefits, such as overcoming literacy barriers (reading) being used globally and easily identifiable, it does not mean all people straightforwardly understand them. It is, thus, necessary that information on chemical labels be placed with the appropriate information of the hazards of the product for all people, taking into account the

differences in education level statuses, cultures and lack of scientific knowledge that exist (Klaschka and Rother, 2012). Therefore, policy that has a focus on the labelling of chemical products is necessary to ensure that the hazards associated it is effectively communicated to the public.

Chemical and pesticide legislation

According to Section 32 (1) of the Constitution, everyone has the right to access "any information that is held by another person and that is required for the exercise or protection of any rights". Furthermore, the Children's Act 38 (2005) states that parental responsibilities include caring for the child, including "safeguarding and promoting the well-being of the child"). As the overall interest of this research was to uphold the basic human right of good health among all children, information on the hazards and risks of household pesticides and chemical products is imperative for caregivers to know.

There are many reasons as to why governments globally regulate pesticides and chemicals; however, the main reason is to protect human health from the risks associated with exposure to the substances (WHO, 2015). Though human health is the common goal for regulating chemicals and pesticides, it is important to note that the regulation details vary in different countries (Handford *et al.,* 2015). For instance, biocide registration is more lengthy and complex in the European Union than in the United States (Frederiks and Wesseler, 2019). In LMICs such as India and China, they have their own pesticide regulatory system where highly hazardous and toxic pesticides are still being used due to inadequate legislation enforcement (Handford *et al.,* 2015). A systematic review on pesticide residues in bananas found that the maximum residue levels that were allowed in Europe, Asia and South America, had misalignments from one another that caused clear differences in their low pesticide concentrations values (Gomes *et al,* 2020).

As countries' chemical registration vary, there are two important international guidelines - the Globally Harmonized System of Labelling and Classification of Chemicals (GHS) and Guidelines on Good Labelling Practice for Pesticides by the Food and Agriculture Organization of the United Nations (FAO), that both aim for safe and harmonized labelling practices. The Guidelines on Good Labelling Practice for Pesticides by FAO have been revised and brought in line with the guidelines in the GHS (WHO, 2015).

According to the United Nations the GHS adopted the 1992 United Nations Conference on Environment and Development (UNCED) mandate (UN, 2019). The first version of the GHS handbook was published in 2003 and has been updated every second year with the last being in 2017 (WHO, 2015, Chemical Safety, 2017). The aim of the GHS is to create "a globally

harmonized hazard classification and compatible labelling system, including material safety data sheets and easily understandable symbols, which should be available, if feasible, by the year 2000" (UNCED, agenda 21, para. 19.27). The GHS focuses on four main sectors, which includes, industrial/place usage of chemicals, transport, consumer products and agricultural chemical usage such as pesticides (Dalvie, Rother & London, 2013). Acknowledging that chemicals are not only used in agricultural settings, transport or within the industrial sectors, but also in households, a standardized label is necessary to protect people from exposure. Particularly, in South Africa, chemicals such as paraffin are commonly used in informal settlements as a source of energy. A study done in Soweto in 1999 found that in informal settlements, 92% of the respondents used paraffin for cooking and 76% used it for heating their dwelling (Westaway, 2006). Globally, citizens, including South Africans, are also exposed to chemicals through personal care products (PCP's) without being fully aware of their risk. PCP's include common substances in the households such as disinfectants, perfumes and fragrances (Montes-Grajales, Fennix-Agudelo & Miranda-Castro, 2017). People's exposures to chemicals will most likely increase as they are continuously in contact with them, often not being aware of the risk.

Therefore, in an attempt to manage the risks that are associated with chemical products and move towards label harmonization, the following elements are required to be on the GHS label: a signal word, hazard statements, precautionary statements and a pictogram to supplement the statements (UN, 2019). Essentially, according to the GHS handbook, harmonisation refers to the establishment of a classification system for chemical hazards that is coherent and has the appropriate elements that accommodates transportation of the products, the consumer/end-user, worker/chemical and pesticide handlers and protects the environment (UN, 2019). However harmonisation is compromised, as there are different studies that recognize that the comprehension of pictograms still poses as a barrier amongst vulnerable groups of society and therefore, there is a need for pictograms to be further researched (Emery *et al* 2015; Banda & Sichilongo, 2006; Rother, 2008; Sathar *et al* (2017). This study focuses on investigating South African caregivers' understanding of existing and newly proposed GHS pictograms while identifying pictogram comprehension barriers and to suggest ways in which pictograms on chemical labels can be improved to facilitate comprehension and understanding amongst South African caregivers.

As South Africa has recently adopted the GHS, it is a requirement that it is incorporated into its national chemical legislation. As the Hazardous Substance Act, 1973 makes provision for "importation, manufacture, sale, use, operation, application, modification, disposal or dumping of such substances and products; and to provide for matters connected therewith" (Act No.15 of 1973). This Act controls the use of chemical products that are likely to cause ill health or death of humans due to their toxic, corrosive or dangerous nature (Hazardous Substances Act, 1973). With

specific reference to pesticide labelling in South Africa, pesticide industries are obliged comply with labelling requirements stipulated by The Fertilizers, Farm Feeds, Seeds and Remedies Act 36 of 1947. Though a mechanism that is used by chemical industries on their labelling to communicate and reinforce the safety information on chemical labels is pictograms. However, chemical industries' motivation could be largely attributed towards compliance to the law rather than whether people are able to follow the provided instructions of use (Rother, 2018).

Chemical legislation in SA provides guidelines and laws on what information should be on chemical labels container. However, although labelling is regulated from a policy perspective, this top-down approach is flawed as many studies report on the lack of comprehension of mechanisms on the labels. Not having a good understanding of the information on chemical labels can have irreversible consequences for both the environment and ultimately, human life. Research shows that vulnerable groups, such as people living in informal settlements, farms, low-income communities and children, are even more exposed to harmful environmental exposures like pesticides and chemicals, than those living in middle to higher income communities (Tolosana *et al*., 2009; WHO, 2010; Weimann and Oni, 2019). However, as noted, comprehensibility thereof remains a concern and therefore, this research will focus on chemical labels (specifically, pictogram) comprehensibility amongst caregivers, ultimately to protect the health of children.

Theoretical concepts

Two main theoretical frameworks that underpinned this research are cultural capital by Pierre Bourdieu and the Semiotics theory respectively by Charles Sanders Peirce. These theories were chosen for the data analysis of the study findings as both have a focus on factors that influence the way individuals understand life and play a role in their decision-making processes. The first theory, cultural capital is centred on the belief that when people live in a certain living environment low or middle or high-income community), and hold similar life experiences and social statuses as their neighbours, they develop the same behavioural habits and lifestyles (Pinxten and Lievens, 2014). Informed decisions and pre-existing ideas that individuals are socialised into believing are factors of cultural capital that can be related to educational attainment an individuals' cultural and belief system (Airhihenbuwa & Webster 2004). Integral to this research was to understand how pictograms lead to positive behaviour change, however before reaching that point, it is important to know whether individuals are able to comprehend the hazard communication message as scientifically intended (e.g.,, the message pictograms aim to deliver). According to Beaufils and Mondon (2013), the knowledge and culture of consumers have can play a role in how they interpret pictograms. Conversely, a study on the comprehension of medical pictograms in diverse South African language groups who had different cultural diversities, found that there were no significant differences in the interpretation of the pictograms

(Dowse and Ehlers, 2004). Another study showed that amongst three different communities where elderly participants were sampled from in Canada, there was an overall comprehension of the pictograms presented to them (Berthenet *et al.,* 2016). Therefore if cultural and environmental differences cannot be a reason for poor comprehensibility of pictograms (factor attributed to the individual), it is important to assess whether the pictogram itself is a barrier towards comprehensibility (external factor not attributed towards the individuals).

The second theory is by Charles Sanders Peirce and called the theory of signs, which is a part of the field of study, Semiotics. It is the study of signs and it is relevant as a pictogram can be considered as a form of a sign. Nöth (2012) argues that semiosis is the study of the processes of signs that represent objects and the effect that the sign has on the person comprehending it. The semiotic theory does not focus on the factors attributed to the person understanding the pictogram, but rather on the pictogram itself. Therefore, the graphic features of a pictogram are important to analyse. The GHS handbook by the United Nations (2019) has very specific elements that all pictograms should have depending on the hazard classification of the chemical. The GHS handbook includes a comprehensibility testing methodology, which is a tool developed to assess comprehensibility of the GHS labels among consumers and workers who are in developing countries (UN, 2019). The tool includes a range of modules that includes testing the comprehensibility of the semiotics such as "size, placement background colour and border of symbols/pictograms" and "comprehension of hazard symbols with and without text" (UN, 2019). What is not clear is whether countries implement this comprehensibility testing.

Therefore, based on the two theories above, in order to understand an individual's comprehension of a hazard communication mechanisms, like a pictogram, both the person's decision-making process and the pictogram's physical characteristics need to be assessed. However, the two aforementioned variables (decision-making process and the physical characteristics of pictograms) that were drawn from the theories should not be viewed independently from one another but rather as variables that have an influence on one another.

2. Methods

2.1 Study design

To achieve the objectives of this study, a cross-sectional mixed-methods approach was used through utilizing both quantitative and qualitative methods. A cross-sectional approach allowed for collecting data on individual's current knowledge and behaviours (based on what they are exposed to), which potentially can be associated with a specific outcome (child poisoning) (Pearce, 2012). Therefore, the study design was beneficial as it assisted in assessing the participant's present understanding of chemical labels. Furthermore, a mixed method approach was used. Both quantitative (e.g., educational levels, language, number of participants agreeing on a pictogram) and qualitative data (e.g., participants reasoning, cultural experiences, recommendations) were relevant as it provided findings and insights relevant to address the objectives of this study.

2.2 Study locations and populations

The research was conducted in two locations in the Western Cape, South Africa - a farm in Paarl and the University of Cape Town (UCT). These locations were chosen due to the population characteristics that represented some of the different types of communities in South Africa. In the protocol, a third location, ChildSafe, was also selected but was excluded due to COVID-19. On 15 March 2020, South Africa declared a national State of Disaster for COVID-19 and as a result, all non-essential activities, including all face-to-face research studies were stopped.

A farming community in Paarl was selected as research showed that farmworkers often have a low educational status (not completing secondary or primary school), which is important when assessing the comprehensibility of pesticide label pictograms (Mokhele, 2011, Rother 2008, Chendrashekaran, 2017). Additionally, the farm in Paarl added another dimension relevant for assessing comprehensibility, as the majority of the residents are Afrikaans speaking (Census, 2011). Only one farm was chosen for this study due to data collection constraints. However, this farm provided valuable findings as farmworkers both lived and worked on the farm and had characteristics (e.g., language, job type and residence) that allowed for informative findings. Additionally, as the study was partially qualitative, farm participant's responses provided rich themes relevant for the research questions. The second study location, UCT, was specifically chosen as it is one of top universities in South Africa and has students from diverse backgrounds. The university allowed for useful comparisons amongst participants with respect to assessing the impact literacy barriers and educational levels have on comprehending pictograms. The data collected in the two locations, although not as much as intended, were sufficient for this mini-dissertation research to address the study objectives.

2.3 Population sampling

Within the cross-sectional study design, non-probability sampling was used and therefore the participants were not selected using a randomization formula. Additionally, both locations had different non-probability sub-methods to accommodate for their specific characteristics. Non-probability sampling was used as participants came from different locations, which added a layer of diversity amongst the responses. Furthermore, non-probability sampling was more beneficial to this study as it allowed the researcher to stay within the timeline of the research and still fulfill the objectives of the study.

Convenience sampling was used for the farmworkers due to the selected farm being within travelling proximity for the researcher and access granted by a key informant farm worker to enter the farm. However, through the use of a key informant farm worker, bias could have been introduced to the study. Therefore, bias was addressed through briefing the key informant worker before assisting the researcher to not approach any farmworkers prior to the study and only play the role of accompanying the researcher to the various households. Additionally, the researcher randomly approached houses without having knowledge on the residents or previously meeting them. The key-informant on the farm was chosen based on availability to access the workers only through coordinating times, days to conduct interviews and access households with the key-informant. However, the key-informant was not chosen due to any relationship that the key-informant had or positional hierarchy in comparison to the rest of the farmworkers.

The key informant assisted the researcher by approaching participants at their homes during their lunch break. The farmworkers were invited to participate in the study after their shift ended and were given a time-slot to meet the researcher. Farm residents who were retired but still resided on the farm were invited to participate in the study if they were still taking care of children (i.e. grandchildren). The participants could decide whether they wanted to be interviewed in an allocated room on the farm or a private room in their house. Initially, thirty-five farmworkers agreed to participate in the study but only seventeen were interviewed due to the lockdown for COVID-19 that stopped face-to-face research.

Purposive sampling was used with the second study population was UCT students. The students were accessed through UCT's Department of Student Affairs (DSA). DSA only sent the research invitation to the students once UCT's Human Research Ethical Committee approved the study. The inclusion criterion was stipulated in the email introduction sent by DSA sent with the online questionnaire link. In the email introduction sent to the students, to increase appeal of participating in the study online, they were included in a lucky draw to win one of ten R100 vouchers to a restaurant in Cape Town. Incentives to participate in the study (lucky-draw offered to students) was not a part of the data collection process at Paarl sample as initially in the

proposal for all the face-to-face questionnaires at the three locations, incentives were not offered and only included in the adapted proposal.

To address the participant's uncertainty of what pictograms meant after the interview, an information sheet from the University of Cape Town's Environmental Health (Appendix 5 or 6) division was distributed in either English or Afrikaans at the end of each session. A PDF version of Appendix 5 was emailed to the students who provided email addresses at the beginning of completing the study.

2.5 Data collection

The data collection tools used in this study included a face-to-face questionnaire with farmworkers and an online questionnaire with UCT students. The farmworkers questionnaire was translated into Afrikaans, piloted and then revised. Participants, however, were given the choice of having the face-to-face questionnaire in either English or Afrikaans. The student questionnaire was only administered in English online, as students are studying in English at UCT. The face-to-face questionnaire and online questionnaire focus was on the hazard communication mechanism, pictograms that are used on chemical/pesticide products labeling. Both the face-to-face questionnaire and online questionnaire consisted of the same four sections. All the sections had a prominent focus on pictograms and labels used on chemical products.

The first section included eight demographic questions. The variables applicable to the research, including age, language, residential type, and educational level, were reported in the demographics section. All the questions in the first section were quantitative and all the variables were categorized. The second section of the questionnaire included a mix of five quantitative and qualitative questions on the participants' awareness of chemicals and labels (e.g., How do you know when a chemical or pesticide is dangerous for children's health?). The questions pertaining to the awareness of chemicals and labels were open-ended qualitative questions where participants were asked to describe what a label is in their own words. Thirdly, the questionnaire included a section with 12 questions related to the comprehension of pictograms (e.g., Looking at the six pictograms below, which one do you think best describes, "Keep out of reach of children"?). This section included questions focusing on proposed and existing GHS pictograms, as well as perceptions of pictograms conveying danger. Appendix 2.1 shows the five pictograms which were presented, Appendix 2.2 shows the nine existing GHS pictograms, Table 6 shows the nine existing GHS pictograms and its matching precautionary statements/definitions and lastly, Appendix 8 shows a laminated sheet containing pictures of chemical and pesticide products.

The same images in Appendix 2.1, 2.2, 7, and 8 were integrated into the online questionnaire. In order to understand if the design of the pictograms had an influence on comprehension, participants were asked if the size and colour of the pictogram draws their attention to looking at it. Furthermore, after converting the questionnaire to google forms, it was slightly adapted to accommodate an online questionnaire for the students. The online questionnaire had one additional question was added to the second section and two to the last section. The extra question included was whether a pesticide or chemical is dangerous for adults. The question was added to understand if the students differentiated between chemical toxicity for adults versus chemical toxicity for children. The second additional question added to the online questionnaire for the students what companies who make chemical products do to make information of their product easily understandable to their community. The additional question was added to the student questionnaire due to their study location not necessarily being their place of residence whereas the farmworkers work and live on the farm. Lastly, question 13.3 was added to ask students where they bought their pesticide products from in comparison to the farmworker questionnaire.

In both questionnaires, the last section focused on identifying barriers towards comprehensibility of chemical label elements (e.g., What other ways would you like to receive information about the dangers of chemicals and pesticides for you and your family?). The 12 questions were divided into three sub-sections and assessed the access participant's had to labels, their ability to verbalize and describe pictures, and their storage and disposal of chemical container practices.

2.5.1 Farm worker face-to-face questionnaire

A face-to-face questionnaire was beneficial due to its qualities that allowed the researcher to read the questions to participants and overcome potential literacy barriers (O'Cathain & Thomas, 2004). The questionnaire was uploaded on CommCare HQ, an online website that facilitates data collection. To increase the efficacy of collecting the data, the application was opened on a secure laptop that is password protected. Participants received a consent form that was verbally read out to them in Afrikaans and an extra consent form for them to keep as the researcher, supervisor and HREC information was provided for their reference. The face-to-face questionnaire was conducted in a secure private room on the farm or in the participant's house (the participant chose their preferred location) where no other people were present to ensure privacy and confidentiality. Each question was read to the participants by the researcher and their responses were typed into the application, CommCareHQ on a laptop. In order to aid the questionnaires, participants received laminated sheets (Appendix. 2.1, 2.2, 5, 7, 8) that they referred to in order to answer questions on comprehensibility and awareness in the questionnaire. Once the interview was completed, the questionnaire was submitted to CommCare HQ and stored in a password protected

account that only the researcher had access to. The researcher of the study interviewed all seventeen participants using this method at the farm in Paarl.

2.5.2 Student online questionnaire

During the data collection process described in 2.3.1, the global pandemic, COVID-19 cancelled the continuation of the face-to-face online questionnaires with all the research sites (Paarl farm and the University of Cape Town (UCT). From the original three study locations, UCT was chosen to continue the data collection process, by using online questions instead of face-to-face questionnaires, as the students are assumed to have computer and internet access. An online questionnaire was appropriate in order to continue the data collection process. The original English questionnaire and consent form was loaded on to Google forms. The Google form responses were linked to a password protected Gmail account that only the researcher had access to.

2.6 Ethical approval

Ethical approval to conduct the study was obtained from the Human Research Ethical Committee (HREC) at the Faculty of Health Sciences of the University of Cape Town. The HREC reference number for this study is 853/2019.

2.7 Data analyses

The data was exported from Google Forms and CommCare HQ to an excel sheet where missing data and duplicate forms were removed and cleaned. The farmworker and student data will not be combined and presented separately.

The quantitative data obtained was entered for analysis into Rstudio to do the test for significance (chi-square) and Microsoft Excel for cross Tables and descriptive statistics. Descriptive statistics, count and percentages were used to summarize the demographic data, gender, age-range, home language, language participant reads in, employment status and highest educated obtained.

The qualitative data collected from the open-ended questions was analyzed according to pre-determined themes using a codebook analysis that was linked to the theories identified in the literature (cultural capital, environment, culture and beliefs), symbolism and meaning of pictograms outlined in the semiotics theory (Pinxten and Lievens, 2014; Laughery & Wogalter 2014; Yakin *et al*., 2014). When participants were asked to justify their choice of pictogram (Table 3), their responses were analyzed according to the semiotics theory that focuses on signs and their meaning. Furthermore, respondents' answers were categorized according to word repetitions as sub-themes. For the rest of the qualitative questions, themes were also created

based on repetitions of answers in each group (farmworkers and students) and used to make comparisons between the two groups' educational levels, cultural experiences and preferences. For example, when participants were asked to provide examples of labels that they have seen recently, categories were created from the emerging themes. The following themes were identified and used as category names for analysis such as food (e.g., coffee jar, cereal, ingredients in egg noodles, oats, chocolate bar, cool drink), pesticides (e.g., weed killer, ant repellant, insect killer), chemical (e.g., drain un blocker, bleach, washing powder) and other (e.g., medication, body cream). In order to further analyze the responses, the students and farmworkers categories "food", "pesticide", "chemical" and "other" were assessed to see whether the two groups commonly saw the same product as having labels on it.

Additionally, the responses to the question asking participants to describe what a label is in their own words, were analyzed according to the UN (2019) definition of a label, that is:

"an appropriate group of written, printed or graphic information elements concerning a hazardous product, selected as relevant to the target sector(s), that is affixed to, printed on, or attached to the immediate container of a hazardous product, or to the outside packaging of a hazardous product".

Although the label definition question was asked qualitatively, participant responses were categorized then analyzed quantitatively according to the scientific definition given in the GHS handbook quoted above. Participants' answers were grouped into three categories, i.e. "correct", "partially correct" or "incorrect". To be classified as "correct", the respondent's answers must include any two of the following key words: "information", "attached", "product", and "instructions" (or the definition thereof). Two key-words were relevant for the participants' responses to be classified as "correct" as based on the GHS definition, it can be seen that it includes both a form of information being delivered and the placement of the information. Therefore, the definition provided by the participants had to describe the important elements included in the GHS scientific information as closely as possible. The inclusion of both elements was important as a more elaborate response provided from the participants limited the researcher from being biased when assessing the correctness of label definitions. The addition of "partially correct" was added, to account for participants who knew what a label was but could not fully verbalize it (taking into consideration literacy barriers) according to the scientific definition by the GHS**.** Furthermore, to assess significance of the results in relation to their educational levels, a chi-square test was performed in R. The participant's qualitative data was placed into categories (correct, incorrect and partially correct), which were then assessed in R.

The GHS handbook was used for evaluating Table 6 whereby participants had to assess whether the GHS precautionary statement suited the matching pictogram. However, in order to analyze the impact of the words used in precautionary statements and the length thereof, the farmworkers and the students received different descriptions to each pictogram. This was done to compare whether the more detailed wording versus the basic definitions is more effective for comprehensibility of the matching pictogram. Farmworkers were shown a laminated sheet (Appendix 9) with nine GHS pictograms and an accompanying basic definition thereof from the GHS handbook. The students were then giving the same nine GHS pictograms, however with more extensive precautionary statements from the GHS handbook that was affiliated with the pictogram (Appendix 11, question 13.2.1).

In the last section of the questionnaire, questions were on asked on the storage and disposal of empty chemical containers. For the question on storage of their chemical or pesticide products, the respondents' answers were categorised as (not within reach/not accessible) if they had the key words "high" and/or "locked" and/or "cupboard that is out of reach" and/or garage/isolated room. The respondents' answers were categorised as (within reach/accessible) if it did not have the keywords "high" and/or "locked" and/or "cupboard that is out of reach" in it. To assess whether disposal of empty containers holds similar caution to users, a question was asked on what the participants does with the empty pesticide or chemical container once the product is finished. The respondent's answers were categorized into themes that emerged from word repetitions in the responses

For the last question of the study, in order to analyze the barriers towards comprehensibility, the participants where asked how chemical labels can help caregivers protect their children from being exposed to the contents of chemical products. The responses of the participants have been categorised according to the themes in the codebook, cultural capital and semiotics. In order to fall within the cultural capital theme, the responses will need to relate to social assets which includes traditions, beliefs and cultures (Pinxten and Lievens, 2014, Airhihenbuwa & Webster 2004) and in order to fall within the semiotics category, the responses will need to relate to signs and its meaning (Nöth, 2013, Yakin *et al.*, 2014).

3. Results

The questionnaire reached approximately 26,419 students at the University of Cape Town and was sent across departments and faculties. From the email sent from DSA, 65 students submitted the questionnaire and 64 gave informed consent and one student did not. From the 64 students, 29 fulfilled the eligibility criteria of being a caregiver to a child between 0-18 years old. DSA only sent out one email invitation to all students to participate the study and were reluctant to send out reminders due to COVID-19 information overload and students being stressed.

3.1 Participant Demographics

The participants in the farm cohort were aged between 24 and 61+, however more than half (70.6%; Table 1) was older than 42 years of age. Conversely, the student participants were aged between the ages 21 – 54 and 61+. The majority (86.2%; Table 1) of the students were younger than 41 years old. Similarly, in both the farmworker and student groups, more females (82.4% and 86.2% respectively; Table 1) participated in the study. Retired farmworkers who still resided on the farm were also included in the study and therefore were described as "unemployed" in Table 1. The educational level attainment amongst the students was expected to be higher, as a prerequisite for tertiary education is the completion of secondary education/a matric certificate. Whereas, amongst the farmworkers, only 18% (Table 1) had their matric certificate and the majority only passed grade 8- 9. Another notable difference highlighted by Table 1 was that the languages students read in were different to languages they spoke, whereas all farmworkers read and spoke in Afrikaans only.

Table 1

Demographics of participants (N=46)

	n (%)
AGE RANGE	
Farmworkers	**N = 17**
18-23	0
24 - 29	1(5.9)
30-35	0
36 - 41	2(11.8)
42 - 47	2(11.8)
48 - 54	5(29.4)
55 - 60	2(11.8)
61 +	5(29.4)
Students	**N=29**
18 - 23	8(27.6)
24 - 29	3(10.3)
30 - 35	8(27.6)
36 - 41	6(20.7)

42 - 47	2(6.9)
48 - 54	1(3.5)
55-60	0
61+	1(3.5)
GENDER	
Farmworkers	**N=17**
Female	14(82.3)
Male	3(17.7)
Students	**N=29**
Female	25(86.2)
Male	3(10.3)
Non-binary femme	1(3.5)
HOME LANGUAGE	
Farmworkers	**N=17**
Afrikaans	17(100)
Students	**N=29**
Afrikaans	1(3.5)
English	20(69.0)
Isi-Xhosa	2(6.9)
Sepedi	1(3.5)
Sesotho	1(3.5)
Shona	1(3.5)
Tshivenda	1(3.5)
Tsonga	1(3.5)
Xhosa and English	1(3.5)
READING LANGUAGE	
Farmworkers	**N=17**
Afrikaans	17(100)
Students	**N=29**
English	17(58.6)
English, Xhosa and Zulu	1(3.5)
English; Afrikaans	9(31.0)
English; Afrikaans; Dutch, German	1(3.5)
English; Shona	1(3.5)
EDUCATIONAL LEVEL	
Farmworkers	**N=17**
Passed grade 8- 9	12(70.6)
Passed grade 10 - 11	2(11.8)
Matric Certificate	3(17.7)

Students	**N=29**
Matric Certificate	7(24.1)
Bachelors Degree	4(13.8)
Honours Degree OR Postgrad diploma	9(31.0)
Masters Degree	8(27.6)
Doctoral Degree	1(3.5)
TYPE OF COMMUNITY	
Farmworkers	**N=**17
Farm	16(94.1)
Suburb	1(5.9)
Students	**N=29**
In a suburb	26(89.7)
In an informal settlement/Township	3(10.3)
OCCUPATIONAL STATUS	
Farmworkers	**N=**17
Full time employed	7(41.2)
Part-time employed	2(11.8)
Seasonal worker	5(29.4)
Unemployed	3(17.7)
Students	**N=29**
Full time employed	7(24.1)
Full time employed; Student	2(6.9)
Part-time employed	3(10.3)
Student	11(37.9)
Student; Part-time employed	5(17.2)

3.2 Awareness and comprehension of chemicals and pesticide labels

Before analyzing whether or not participants could comprehend labels, it was important to understand their awareness of chemical labels. Table 2 presents how both farmworkers and students described what a "label" was in their own words. In order to achieve a "partially correct" answer, one of the identified key words had to be in their response, and "incorrect" answer was one where none of the keywords were provided. The majority of the students' responses were correct (75.9%), compared to 41% of farmworkers; more participants in the farmworker cohort had incorrect answers (23.5%) than the student cohort (3.5%).

Table 3 illustrates the relationship between correctly defining labels with educational level. Among farmworkers, educational levels were distributed across the different categories (correct, incorrect and partially correct). In contrast to the student cohort, the majority of participants who correctly defined a label had a Master's degree, although not significant (3.0%; p=0.223).

However, enforcing a stricter criterion on what constitutes *correctness* by collapsing "partially correct" into the "incorrect" category reduced the p-value, but not significantly (2.5%; p=0.115).

Table 2

Participants' ability to define a label according to the GHS official definition (N=46)

	Correct n (%)	Partially correct n (%)	Incorrect n (%)	N = 46
Farmworkers	6 (35.3)	7 (41.2)	4 (23.5)	17
Students	22 (75.9)	6 (20.7)	1 (3.5)	29

Table 3

Participants' ability to define a label compared to their level of education (N=46)

	Correct n (%)	Partially correct n (%)	Incorrect n (%)
Farmworkers (N = 17)			
Passed grade 8- 9	4 (66.7)	5 (71.4)	3 (75.0)
Passed grade 10 – 11	1 (16.7)	0	1 (25.0)
Matric Certificate	1 (16.7)	2 (28.6)	0
Students (N = 29)			
Matric Certificate	6 (27.3)	1 (16.7)	0
Bachelors Degree	2 (9.1)	1 (16.7)	1 (100)
Honours Degree OR Postgrad diploma	9(40.9)	0	0
Masters Degree	4(18.2)	4 (66.7)	0
Doctoral Degree	1(4.5)	0	0

When the participants were asked to identify where they have recently saw a label, both farmworkers and students responses fell into the following themes: "on a food product", "on a pesticide" and "other". Overall, among the farmworkers, 76% gave examples that ranged from food product labels or chemical product whereas 24% gave examples that were not related to a label. From the farmworker examples of labels, there was no agreement to a prominent product label, as 24% said "on a chemical product", 24% "on a food product", 18% "on a pesticide" and the rest had unique examples where a theme did not emerge. On the other hand, from the students, 93% gave responses that ranged from food products labels to chemical product labels and 7% did not give a label example. From the students' examples of labels, 41% indicated labels being found on food products, 14% on pesticide products and 7% on household chemical products. Interestingly, the farmworkers identified seeing labels on pesticides and chemical

products more than students did. From the students' examples, they saw labels more on food compared to the farmworkers.

After presenting various pictures of chemical products **(**Fig. 1**)** used for household cleaning, all of the participants (100%) in both cohorts indicated using one or more of the chemical products presented. Although all of the participants used one or more chemical products, not all of the participants gave examples of them when asked which products they have seen a label on. Participants were also shown both commercial and illegal pesticide products (Fig. 1) used for killing pests in and around homes. Among students, 34% did not use any of the pesticide products to kill pests, 10% used organic products, 31% used commercial pesticides and 31% used street pesticides. Important to note, from the various products listed on the point chart (Fig. 1), 88% of farmworkers used street pesticides (example Fig. 2**)** and the rest used commercial products.

Fig. 1

Point chart with chemical and pesticide products that was shown to the participants

Fig. 2

Common street pesticide used by participating farmworkers

FRONT **BACK**

3.2.1 Assessing dangers of chemicals for children

When asked how they knew whether a chemical could be harmful to a child's health the farmworkers cited: "the smell of the product is strong for a child/adult" (causing adverse health effects such as coughing) (41.1%), "the label will have information on the harmful effects of the product on children's health" (35.3%) and "both the strong smell and label will indicate danger to children (5.9%)". For the participating students, the dominant emerging themes from this question were that the label indicated either that the product was dangerous for children when the "keep out of reach of children" label was used, when there were warnings on the product labels (44.8%) and that all chemicals or pesticides are dangerous for children's health (17.2%), though the label would be an indication of danger to children, all products are still regarded as dangerous to children (17.2%). Other responses from the students and farmworkers varied and a significant theme did not emerge (e.g., the chemical or pesticide product is not edible and therefore it is not safe for children, advice from others that the chemical or pesticide product is dangerous for children's health).

3.2.2 Assessing dangers of chemicals for adults

An additional question added in the student questionnaire was how students knew that a product was dangerous for adult health (in contrast to child health). The prominent themes that emerged were all chemical and pesticides were dangerous and labels indicate the dangers (20.7%) and ~~that~~ the label and precautionary statement indicates dangers to adults (20.7%). Others themes included: strong smell, coughing after inhaling the product, skull and cross bone pictograms, details on labels, intuition, hazards and allergies (combined, 3.5% for this category). Three responses that were unique were:

> *"All are but I'm not sure what the actual dangers and risks are with general use though I'm aware of the precautionary symbols*"

> *"Label and precautionary statement. Some of these hardly make sense from the detailing of specific product but simple English that says the effects and what to keep product away from helps."*

> *"The probably usually are, but what can we do if there is a problem with insects? It would be nice for everyone to be given protective equipment with the pesticide"*

3.3 Comprehension of GHS label pictograms

3.3.1 Evaluating GHS current pictograms

Both students and farmworkers (N=46) were presented with pictures of the nine current GHS pictograms (Table 4). When asked which one they had recently seen on chemical or pesticide products, 87% of the overall sample indicated pictogram 4: "the skull and crossbones". The second most frequently seen pictogram was pictogram 2 (72%). Pictogram 9, the "exclamation mark", was the third most seen by (50%). For the remainder of the pictograms, no more than 10% of the participants saw the pictograms on a recent chemical or pesticide product they had used.

Table 4

Current GHS Pictograms seen by participants on a chemical product already (N=46)

GHS Pictograms	Farmworkers (N=17)	Students (N=29)	Total (N=46)

	n (%)	n (%)	n (%)
Pictogram 1	2 (11.8)	1 (3.5)	3 (6.2)
Pictogram 2	8 (37.1)	25 (86.2)	33 (71.7)
Pictogram 3	1 (5.9)	1 (3.5)	2 (4.4)
Pictogram 4	14 (82.4)	26 (89.7)	40 (87.0)
Pictogram 5	1 (5.9)	3 (10.3)	4 (8.9)
Pictogram 6	1 (5.9)	1 (3.5)	2 (4.5)
Pictogram 7	2 (11.8)	2 (6.9)	4 (8.9)
Pictogram 8	0	5 (17.2)	5 (10.9)

Pictogram 9	6 (35.3)	21 (72.4)	27 (58.7)

Following the identification of the nine pictograms, participants were asked to describe the meaning of each GHS pictogram in their own words (Table 5). Due to missing responses, only 65% of the farmworkers gave descriptions for all of the nine GHS pictograms (Table 5). Among students, one participant did not provide an answer for any of the pictograms and was classified as missing data. Thus, 97% of the students gave descriptions for all nine GHS pictograms.

Pictograms 1, 2, 8 and 9 (Table 5) received the same description by the majority of the participants. The most common theme chosen for pictogram 1 was "flammable/fire" (57.1% by farmworkers and 71.4% by students). In both the farmworker and student group, 14% said they did not know what the pictogram meant. Similarly, for pictogram 2, 67% of the farmworkers and 89% of the students described the pictogram as "flammable" and pictogram 8 was related to being hazardous to fish, animals, and the environment. Lastly, from the thirty-one respondents for pictogram 9, 54% of the farmworkers and 85.7% of the students related it to a form of warning or danger.

Pictogram 3, 4, 5 and 6, 7 did not receive the same description by students and farmworkers, instead different themes emerged (Table 5). The majority of students (75.0%) described pictogram 3 as "explosive" whereas the highest category for the farmworkers said they did not know (28.5%). For pictogram 4, more than half of the farmworkers (56.3%) described the pictogram as representing "danger/beware" whereas more than half of the students (53.6%) described the pictogram as representing "fatality". The majority of the farmworkers (72.7%) did not know what pictogram 5 meant, whilst 50% of the students described the pictogram as "can burn skin" and 32% described it as "corrosive". Lastly, for pictogram 6, farmworker responses varied vastly with the highest category being that they did not know (15.4) and more than half of the students (57.1%) did not know what it meant.

Table 5

Participants' definitions for nine GHS pictograms grouped into themes (N=46)

Pictogram	**Farmworkers**	**Paarl N (%)**	**Students**	**UCT N (%)**

Pictogram 1		n=14*		n=28*
	Flammable/Fire	8 (57.1)	Flammable/ fire	20(71.4)
	Danger	2(14.3)	Combustible	1(3.6)
	Dangerous	2(14.3)	Able to burn	1(3.6)
	Don't know	2(14.3)	Oxidizing	1(3.6)
			Inflammable/sport trophy	1(3.6)
			Don't know	4(14.3)
Pictogram 2		n= 15*		n=28*
	Fire/Flammable	10(66.7)	Flammable	25(89.3)
	Plant for growth	1(6.7)	Danger/fire	1(3.6)
	Burns	2(13.3)	Combustion	1(3.6)
	It is safe	1(6.7)	Legalizing marijuana	1(3.6)
Pictogram 3		n=13*		n=28*
	Product can splash/squirt	2(15.4)	Explosive	21(75.0)
	Spark	2(15.4)	Product can break	3(10.7)
	Warning about danger	1(7.7)	Can explode	1 (3.6)
	Do not walk	1(7.7)	Dropping product will cause Sparks or shattering	1(3.6)
	Explosive	1(7.7)		
	Product can break	1(7.7)	Don't know	2(7.1)
	Don't know	5 (28.5)		
Pictogram 4		n=16*		n=28*
	Danger/Be aware	9(56.3)	Fatality	15(53.6)
	Dangerous to inhale	2(12.5)	Danger/toxic	9(32.1)
	Poisonous and/or deadly	2(12.5)	Harmful to human health	4(14.3)
	Skeleton/Human head	2(12.5)		
	Deadly	1 (6.3)		
Pictogram 5		n=11*		n=28*
	Hand related/poison	5(45.5)	Can burn skin	14(50.0)
	Do not let it touch/can burn	2(18.2)	Corrosive	9(32.1)
			Melt metal/acid burn	2(7.1)
	Something that can be picked up	1(9.1)	Don't know	3(10.7)
	Can cause allergy or rash	1(9.1)		
	Don't know	8(72.7)		
Pictogram 6		n=11*		n=28*
	No drinking/drinking bottle	2(18.2)	Bottle/cricket bat	8(28.6)
			Alcohol	3(10.7)
	Something that fell on your hands	1(9.1)	Product contains compressed gas inside	1(3.6)
	Do not to play with it.	1(9.1)	Don't know	16(57.1)
	Gas bottle	1(9.1)		
	Bleach bottle	1(9.1)		
	Matches	1(9.1)		

Fire/burn	1(9.1)		
Bottle	1(9.1)		
Don't know	2(18.2)		

Pictogram 7	n=12*		n=28*
	Respiratory/chest hazard	3(25.0)	Harmful to human health/internal harm.	13(46.4)
	Person/human			
	Dangerous	3(25.0)	Respiratory/chest hazard	10(35.7)
	Wear a mask	1(8.3)	Poison	1(3.6)
	Negative impact on health	1(8.3)	Radiation	1(3.6)
		3(25.0)	Don't know	3(10.7)
	Don't know	1(8.3)		

Pictogram 8	n=12*		n=28*
	A fish/animal and a tree	7(58.3)	Environmental hazard	12(42.9)
	Chemical can be poisonous to some animals.	1(8.3)	Hazardous to fish	10(35.7)
			Hazardous to animals	3 (10.7)
			Harmful to all life	1(3.6)
	Poison in water	1(8.3)	Harmful to both fish and the environment	1(3.6)
	Can drown in water	1 (8.3)		
	Not dangerous	1(8.3)	Did not know	1(3.6)
	Strong smell	1(8.3)		

Pictogram 9	n=13*		n=28*
	Warning sign/stop/danger/be careful	7(53.8)	Warning/Danger/Caution/Stop alert before using product	24(85.7)
	A container to keep water in	1(7.7)	Skin irritation	1(3.6)
	Looks good	1(7.7)	Had no comment	1(3.6)
	Exclamation mark	2(15.4)	Don't know	2(7.1)
	Don't know	2(15.4)		

* Missing value for pictogram 1 to 9

* Missing values among farmworkers for pictogram 1 to 9

Participants were asked to describe in their own words which pictograms they thought conveyed danger to the health of adults. More than half of the students (62.1%) described pictures showing a negative human health effect, such as a picture depicting a human body with a line through it or a "Rest in peace" sign or a cross and skull bone pictogram (e.g., Pictogram 4; Table 5). The rest of the participants' answers varied from a danger sign/a picture that is red and/or a triangle

(3.4.%), a chemical stored out of reach/in a high location and with personal protective equipment (PPE) pictures (3.4%), and 7% participants were unable to describe an example. Four participants had unique answers:

> "*There is no pictogram that fully captures the dangers to health. They usually write on the canisters, "if ingested or contact with skin wash or see a doctor". This does not tell the user much about what the product does to their health if inhaled or ingested etc.*"
>
> "*The exclamation mark in the red triangle. To me it illustrates a warning, but does not connect to the actual irritability it attempts to warn against"*
>
> *"It depends on how the chemical will impact the health. Images of all specific consequences may be better to provide a clearer understanding of all the potential dangers associated with the product"*
>
> *"Cross and skull bones and GHS health hazard show this most clearly, although I wouldn't consider any as being 'safe' for my health"*

In contrast to the students, farmworkers' responses was categorized into themes that related to the colour red emphasizing danger to health (29%) and 29% said that a picture of a fire would communicate that chemical products were dangerous to health. The rest of the participants had individual specific answers to describe a picture such as:

> *"A man with poison"*
>
> *"I won't use it"*
>
> *"I will get someone to help me"*
>
> *"A picture with a big "G" for "gewaar""* (referring to danger in Afrikaans).

Participants were then asked to describe a picture they felt communicated health risks for children. The answers of the participants were grouped into themes according to word repetition. Two common themes for students were: (1) a picture showing a behaviour that should be avoided by a child and (2) a picture that is red in colour or has a cross going through it (37.9%). Students also preferred having an image that showed a sick child (24.1%). The rest of the responses did not follow a coherent theme and responses ranged from existing GHS pictograms such as the "flammable" pictogram and the GHS pictogram of skull and cross bones. One participant was not

sure and another said no pictogram could describe health dangers for children. From the farmworkers, none of the responses included "children" in them or referred to children's health despite the question explicitly asking for this. The only emerging theme was to have a picture that illustrates inhaling chemicals causing health effects as 35% of the participants used the words "strong smells" "chest" and/or "inhalation". The GHS pictogram "flammable", "skull and cross bones" and "health hazard" were referenced by 17% of the participants. The rest of the descriptions were specific to the individual and ranged from (e.g., a man with a rope, if I work with it I can pick up a germ, a human and animal and fruit and a picture showing the consequences to a person).

3.3.2 Interpretation of hazard statements

As seen in table 6, the pictograms that received the highest consensus were pictogram 2 (defined as flammable to farmworkers and extremely flammable gas to students) and pictogram 3 (defined as explosive to farmworkers and explosive; mass explosion hazard to students).

The pictogram that had the least consensus between the farmworkers' and students' definitions was pictogram 1. For pictogram 1, almost half of the farmworkers (46.2%) did not know whether the simple definition "oxidizing" describes the pictogram. On the other hand, more than half of the students (55.2%) agreed that the precautionary statement "may cause fire or explosion"; strong oxidizer" suited the pictogram.

Table 6

GHS definitions (bolded) compared to participants definitions (N=46)

Pictogram	GHS Definitions farmworkers	n(%)	GHS Definitions students	n(%)
Pictogram 1	**Oxidizing**	n=13	**May cause fire or explosion; strong oxidizer**	n=29
	Don't know	6(46.2)	Don't know	0
	No	4(30.8)	No	4(13.8)
	Yes	3(23.1)	Yes	16(55.2)
	Partially	0	Partially	9(31.0)
Pictogram 2	**Flammable**	n=13	**Extremely flammable gas**	n=29
	Don't know	0	Don't know	0
	No	1(7.7)	No	4(13.8)
	Yes	12(92.3)	Yes	20(69.0)
	Partially	0	Partially	5(17.4)
Pictogram 3	**Explosive**	n=13	**Explosive; mass explosion hazard**	n=29

	Don't know	1(7.7)	Don't know	0
	No	0	No	1(3.4)
	Yes	12(92.3)	Yes	26(89.7)
	Partially	0	Partially	2(6.9)
Pictogram 4	**Toxic**	n=13	**Fatal when in contact with skin**	n=29
	Don't know	1(7.7)	Don't know	0
	No	2(15.4)	No	12 (41.4)
	Yes	9(69.2)	Yes	9 (31.0)
	Partially	1(7.7)	Partially	8(27.6)
Pictogram 5	**Corrosive**	n=13	**Causes severe sin burns and eye damage**	n=29
	Don't know	5(38.5)	Don't know	0
	No	2(15.4)	No	6(20.7)
	Yes	6(46.2)	Yes	15(51.7)
	Partially	0	Partially	8(27.6)
Pictogram 6	**Compressed gas**	n=13	**Contains gas under pressure, may explode if heated.**	n=29
	Don't know	1 (7.7)		
	No	3(23.1)	Don't know	1(3.4)
	Partially	0	No	12(41.4)
	Yes	9(69.2)	Partially	2(6.9)
			Yes	14(48.3)
Pictogram 7	**Health Hazard**	n=17	**May cause allergy or asthma symptoms breathing difficulties if inhaled**	n=29
	Don't know	0	Don't know	0
	No	2(15.4)	No	6(20.7)
	Yes	15(88.2)	Yes	16(55.2)
	Partially	0	Partially	7(24.1)
Pictogram 8	**Environmental Hazard**	n=13	**Very toxic to aquatic life with long-lasting effects**	n=29
	Don't know	2(15.4)	Don't know	0
	No	4(30.8)	No	4(13.8)
	Yes	7(53.8)	Yes	15(51.7)
	Partially	0	Partially	10(34.5)
Pictogram 9	**Exclamation mark**	n=13	**May cause an allergic skin reaction**	n=29
	Don't know	1(7.7)	Don't know	0
	No	3(23.1)	No	14(48.3)
	Yes	9(69.2)	Yes	12(41.4)
	Partially	0	Partially	3(10.3)

*Four of the farmworkers had missing responses for pictograms 1-6 and 8-9

3.3.3 Evaluation of proposed pictograms

Five pictograms were presented to all participants to assess which one they felt best described the precautionary statement *Keep out of reach of children"* (Table 7). More than half of the participants (56.8%) chose pictogram 1 as the best at communicating the statement (Table 7). Pictogram 2 and 5 (Table 7) were the second highest choices. Out of both study populations, pictogram 4 was not selected at all. Participants were asked to explain their choices in Table 7. From the 56% farmworkers who chose pictogram 1 as most comprehensible, the dominant theme that emerged from the data was that the image showed chemicals placed in a high location, illustrating that it was out of reach of children. Three farmworkers chose it because the product indicated danger. Among students, two dominant themes for the choice of pictogram 1 emerged. Fifty-nine percent of the responses said that pictogram 1 placed emphasis on the child reaching up and/or the product was placed out of reach/ on a high shelf, and 41% of the responses were because the toy in the child's hand illustrated that the warning was aimed keeping the product out of the child's reach. Examples of the top three pictograms responses are summarized in Table 8.

Table 7

Respondents' selection of best-proposed pictogram to convey the "Keep out of reach of children" (N=45)

Proposed Pictograms	**Farmworkers (N=16)**	**Students (N=28)**	**Total (N=45*)**
Pictogram 1	9 (56.3)	17 (58.6)	26 (57.8)
Pictogram 2	4 (25.0)	3 (10.3)	7 (15.6)

Pictogram 3	0	5 (17.3)	5 (11.1)
Pictogram 4	0	0	0
Pictogram 5	3 (18.8)	4 (13.8)	7 (15.6)

*One missing value for farmworkers

Table 8

Examples of the participants' reason for choosing either pictogram 1, 2 or 5 in table 3

	Students	Farmworkers	English translation of farmworkers responses
Pictogram 1	"It shows a child reaching up for something where as the other pictures may be interpreted by various individuals in different ways because the message isn't clear."	"Om dat dit hoog is en dan trek die kind dit af en dit val op die kind"	Because it is high and then the child pulls it down and it falls on the child.
	"The toy really drives the idea that it's a kid"	"Want dit moet hoog bere waar kinders dit nie kan naarby kom nie"	Because it must be stored high where children cannot approach it.
	"You are able to distinguish that the person in the pictogram is a child based on the stuffed toy it is holding. Making the diagram clear that the product needs to be kept out	"Dit wys die kind en die gif moet hoor wees buite die bereik van kinders."	It shows the poison must be high and the child and out of reach of children.

	of reach from children” “It shows a child clearly (teddy bear) and also shows that the child can still reach the product, and that the need for the product to be out of reach.”	“Om rede hy het n rooi krys wat bedoel gewaar.”	Because the red cross means danger.
Pictogram 2 	“The red circle is bold and has a picture of a child and therefore seems dangerous for any age” “Contains a child and an object that should not be touched” “"Process of elimination really – 1 can be interpreted as 'do no put it in a shelf' 3 - one currently used for plastic and small parts on toys 4 - 'no crawling babies, no indication of older children or a container 5 - unable to decipher exactly what this image means"	“Bly heeltemal van hom weg. moenie eers aanvat nie, al is dit NIE eers hoog nie” “Want daar is n bottle” “Mees verstaanbaar” “Dit lyk soos of dit geen gebruik word/alcohol vir kinders”	Stay away from it completely. do not even touch it, even if it is not high Because there is a bottle. Most understandable. It looks like it is not used / alcohol for children.
Pictogram 5 	“I think the other are ambiguous” “The one I chose is best because it clearly shows a child (but this is not very clear from the silhouette) and the positioning of the agents right in front of him/her with the big red line going through it tells me That this person should not getting access to these product. The big red line tells me to be aware and that Alerts me of danger." “It needs to be simple enough to be easily identified when	“Hoog op raak lyk toegesluit” “Om dat daar n prentjie is van die seun en die streek oor dit se dit verbode middle” “Want dit is n aanleiding wan alle kinders (from baby to older children)”	High up and seems locked up Because there is a picture of the boy and the region about it says forbidden middle Because it is an indication for all children (from baby to older children).

	printed small. Picture 1 is actually the most expressive but there is too much detail. I think a combination of pictures 2 and 5 would be best"	
	"It shows a child reaching dangerous stuff"	

In both the student and farmworker cohorts, the majority of the participants, 83% and 82% respectively, agreed that the colour of the pictograms drew their attention. Only 6% of the farmworkers disagreed and 12% were not sure. Similarly, in the student cohort, only 10% disagreed and 7% were not sure. With respect to the size of the pictogram, more than half of the participating farmworkers (58.8%) and students (75.9%) agreed that the size of the pictogram drew their attention to it. In contrast, 35% of farmworkers and 10% of students disagreed, and 6% and 14% respectively were not sure.

3.4 Barriers towards comprehensibility

3.4.1 Place of purchase

Among farmworkers, four participants had missing data. From the remaining farmworker responses, 62% said their chemical and pesticide products had labels on them, 31% said some had labels on them, and 8% said none had labels. Among students, 66% said all their chemical and pesticide products had labels, 20% said only some did, 10% were not sure, and 3% indicated not all products had labels.

Additionally, participants were they mostly bought their chemical and pesticide product. As seen in Table 9, the most common place where both students and farmworkers purchased their chemical products was from grocery stores (75.9% and 94.1% respectively). In all participants, less common places for purchasing chemicals included from informal venders (street sellers) (5.8% among farmworkers and 3.4% among students) and spaza shops [an informal store where products are sold from a house or small shack and often found in a township or low-income community] (6.8% among farmworkers only) (Charman *et al.,* 2012; Chebelyon-Dalizu *et al.,* 2010). Interestingly, the students purchased their pesticide products from a variety of places with a grocery store being the most common (75.9%).

Table 9

Places where sample purchase their chemical and pesticide products (N=46)

	n (%)

Farmworkers purchasing both their chemical and pesticide products from	**17**
Bought from a grocery Store	16 (94.1)
Bought from an informal vendor (street sellers)	1(5.8)
Students purchasing their chemical products from	**29**
Bought from a grocery store	27 (93.1)
Buy from a grocery store and buy from spaza shop	2 (6.8)
Students purchasing their pesticide products from	**29**
Bought from a grocery store	22 (75.9)
Bought from a grocery store; Bought from spaza shop	2(6.8)
Bought from a grocery store; Other	1 (3.4)
Bought from an informal vendor (street sellers)	1(3.4)
Other	3(10.3)

3.4.2 Other media for communicating hazards

All participants were asked whether chemical products provide enough information of the health effects and dangers that are associated with it. Eighty-eight percent of the farmworkers agreed and 12% disagreed with the question. However, on the other hand, in comparison to the farmworkers, the results where nearly split amongst the students as 45% disagreed and 55% agreed that the information on chemical products is sufficient.

3.4.2.1 General sources of information (Table 10.1)

Participants were asked for other ways in which they might like to receive information about the dangers of chemicals and pesticides for themselves and their families. As seen in Table 10.1, themes that emerged from the farmworkers responses were that product manufacturers or product experts should conduct presentations of the dangers (29.4%).

The majority of students preferred to have more information provided through existing labels – though they were asked to provide other ways other than a label (41.3%) (Table 10.2). They indicated this could be made more effective if there was extensive information and an attached information leaflet on the product. However, interesting responses to note are:

"This is a hard one as some containers are too small, and all limited information can be put there. Those who try by putting a leaflet inside, sometimes as consumers we don't read them. So regardless each person needs to take charge of their health. So I will say the companies should at least provide health hazard information than entice us what is used to create a specific aroma (which is a selling point, but that should be very limited)"

"Chemicals must have inserts just like how medicines have inserts inside the packaging. Sometimes the label does not tell you enough and you have to go digging for information online. Even then you may not find the right product because it might not be listed. If there is no insert, there should be some online website that keeps information of all the chemicals common products we use in the country with their risks"

Though not a prominent theme that emerged from the data, a participant raised a valuable point:

"In the past 6 months, I haven't used non-labeled chemicals, but I have before then, and my extended family still does. I feel as though many informal vendors and other sellers in low-income areas (who sell their products at competing prices) are not regulated. Many of these vendors compare their products to popular products on the market, and so many buyers assume the ingredients are the same. Information about cleaning products and chemicals should be better regulated"

Table 10.1

Participant's suggestions for receiving more information on the dangers of chemical products (N=46)

	n	(%)
Farmworkers	**n=17**	
Expert or chemical producers	5	(29.4)
Newspaper articles, google	2	(11.8)
Store where it is purchased from	2	(11.8)
Don't know	2	(11.8)
Ask neighbours	1	(5.9)
Don't see a reason for more information	1	(5.9)
Everything enough on the label	1	(5.9)
Google	1	(5.9)
I put water in a bucket and put the chemical in	1	(5.9)
Label	1	(5.9)
Students	**n=29**	
Extensive label/extra leaflet attached to the product	12	(41.3)
Social media	2	(6.9)
Television, internet, newspapers, radio, community outreach	2	(6.9)
Online: websites	2	(6.9)
Adult and child specific educational programmes	1	(3.4)
Clear warming in advertising	1	(3.4)
Don't know	1	(3.4)
Educational talks at schools, "adverts" in newspapers or news websites	1	(3.4)
Health professionals	1	(3.4)

In store on the shelves where products are sold	1	(3.4)
Independent bodies that review chemical products	1	(3.4)
NA	1	(3.4)
Regulation	1	(3.4)
SMS adverts	1	(3.4)
Upon purchase by sales stuff	1	(3.4)

3.4.2.2 Additional ways in which chemical industries can communicate hazards (Table 10.2)

An additional question asked to students about what chemical companies could do to make the information of their product more easily understandable to the communities they reside in. The most favorable methods indicated by the students were print advertisements (27.6%); billboards/flyers/pamphlets, and online television, Internet, newspapers, radio and social media (24.1%).

Table 10.2

Students preferred methods for receiving chemical related information (N=29)

Student responses	**n(%)**
Use of print advertising mechanisms in communities: billboards/flyers/pamphlets	8(27.6)
Presentations and educational talks use of simple illustrations through pictures.	6 (20.7)
Online television, internet, newspapers, radio, social media of the dangers of the product	7 (24.1)
Enhance existing label	3 (10.3)
Use the local language/various languages	2 (6.9)
Independent companies not associated with chemical company to review safety.	2 (6.9)
Did not understand question	1 (3.4)

All participants were asked how they obtained information on chemical products that they used. As seen in table 11, most of the participants read the information on the chemical containers (47.1% amongst the farmworkers and 79.3% amongst the students).

Table 11

Ways in which participants obtain information on how to use chemical products (N=46)

	n(%)
Farmworkers	**n= 17**
Read information on the chemical container	8 (47.1)
Ask shopkeepers where you bought the product on how to use a chemical product	4 (23.5)
Multiple sources (Ask shopkeepers where you bought the product on how to use a chemical product; Read information on the chemical container; Use the pictures on chemical labels and follow the instructions given; I use instructions that are verbal from an external person)	1 (5.9)
I use instructions that are verbal from an external person	1(5.9)
Read information on the chemical container	1(5.9)
I use instructions that are verbal from an external person	
Use the pictures on chemical labels and follow the instructions given	1(5.9)
Other	1(5.9
Students	**n=29**
Read information on the chemical container	23 (79.3)
Use the pictures on chemical labels and follow the instructions given	6 (20.7)

3.4.3Ability to link precautionary statements to images (pictograms)

To assess whether participants had their own idea of a picture indicating danger (in relation to specific semiotic elements that stood out), they were given three existing GHS precautionary statements/phrases and asked to describe in their own words a picture that would best illustrate it.

The first GHS precautionary statement presented to the participants was, *Avoid contact during pregnancy/while nursing*. Nearly half of the students (48.3%,) described both a pregnant mother and a woman breastfeeding with a cross going through it, 28% students described a picture with only a pregnant mother and a cross through it only, 21% described just a pregnant women or breastfeeding mother and lastly, 3% described a picture only with a breastfeeding mother. The responses from the farmworkers provided less detail than the students. Among farmworkers, 41% described a pregnant woman only, 12% described a pregnant woman with a line going through it, 18% did not know and 29% gave answers that were not related to the precautionary statement.

The second statement that participants were asked to describe was *Do not get in eyes, on skin, or on clothing*. Among students, 59% described an image of eyes, skin, or clothing that had a cross/line/exclamation mark through it, and 17% described a picture that indicated an adverse health effect such as burning skin or illustrating droplets falling on skin, hands, or clothes (being washed). Whereas, 10% of the students gave brief descriptions (describing a picture of an eye, skin or clothing only) and another 10% described a picture of personal protective equipment (PPE), only 3% of the students could not provide a description. In contrast to the clear and detailed responses from the students, the farmworkers' responses were shorter and did not have a theme that dominated. For example, 29% referred to existing GHS pictograms, the flame and skull or crossbones, 24% described a picture with eyes, skin or clothing (covering skin), 24% described personal protective equipment and the rest of the participants (29.4%) had unrelated answers to the precautionary statement (e.g., show the image on the spray and pills sticker).

In relation to safeguarding children from chemicals, participants were asked to describe a picture for *Keep out of reach of children*. More than half of the students' descriptions (62.0%) were the same as pictogram 1 in Table 6 where they described the picture of a child/child with a toy in their hand reaching to a container and a cross going through it. Whereas, 13.8% described only an image of a child and an image of a product that is stored some place high. While, 3.4% were not sure, 3.4% named a child only and described a child with different warning signs, and 3.4% gave an unclear reference to an earlier question. From the farmworker cohort, the only theme that emerged from the responses that could be grouped was a description of pictogram 1 in Table 6 where a child is reaching and a cross through them (23.5%). Furthermore, 23.5% of farmworkers described a picture of a child with words to supplement/reinforce "Keep out of reach of children". The rest of the responses were individual-specific and varied between participants, but all had no detail (e.g.,, a fire, use of the colour red and a picture of a child).

3.5 Words that describe danger to health

Participants were asked to provide words that could be placed on chemical labels to adequately communicate the health risks associated with the product. Participants provided one or more words. Among students, 98 different words were provided as examples to indicate a health effect. Table 11 outlines the various participant suggestions provided by theme. Though the responses varied across the different groups, themes were identified through repetitive wording and similar meanings.

As seen in Table 12, majority of both cohorts of participants preferred words that alerted them to health effects such as the use of the word "danger" and "warning". However, the students' second highest words fell within the category "acute" (e.g., "death" or "serious harm to

humans"; Table 12). Among farmworkers, the second highest word category were non-health words such as "flammable" and the ingredients or best before/expiry date of the chemical.

Table 12

Participant's words that described danger to human health (N= 46)

	n(%)
FARMWORKERS	**n=17**
Acute	2 (11.8)
Deadly	2
Danger/Warning in Afrikaans	2
Gewaar (Danger)	2
Words to alert user	8 (47.1)
Harmful	2
Be careful	1
Warning	2
Danger	2
Beware	1
Non-health	8 (47.1)
Non-usable	1
Picture of insect/pest dead	1
Flammable	1
Company to put re-assuring word on	1
Strictly off limits	1
If you may be using a chemical	1
Best before date	1
All the ingredients in the product	1
Child precaution	4 (23.5)
Keep out of reach of children	1
Will make children sick	1
Be careful - dangerous for children: can get cause hospitalisation or sickness	1
Children may not handle product only adults.	1
STUDENTS	**n=29**
Acute	13 (44.8)
Death/kills	6
Fatal	1
Poisonous	2
Toxic	4
Danger with specific health consequence	10 (34.5)
Dangerous when ingested/swallowed/inhaled	4
Do not touch with bare hands/skin	2
Wear mask	1
Name the body part at risk	2
Danger, not to be... may cause, causes, contain	1

Words to alert user	29 (100)
Danger	14
Warning	4
Caution	2
Harmful	3
Unsafe	1
Avoid	1
Beware/Hey you! /take care	1
Be careful	1
Hazardous	1
Handle with care	1
Health specific	11 (37.9)
Health risk/hazard	5
Injury	1
Burns	1
Suffocation	1
Hospitalisation	1
Can cause chest concern	1
Affect vision	1
Non-health	10 (34.5)
Explode	1
Extremely	1
Effects	1
Damage	1
Flammable	2
Explosive	1
Hazardous	1
Corrosive	1
Dangerous to environment	1
Child precaution	2 (6.9)
Danger to children	1
Harmful to children under 5 years old	1

3.7 Chemical storage practices

To further understand potential barriers towards comprehensibility of pictograms, chemical and pesticide and storage practices were assessed. As seen in Table 13, the majority of participants correctly understood that chemicals and pesticides should be placed away from minors: farmworkers (82.4%) and student (75.9%) cohorts.

Table 13

Participant's storage pesticides and chemicals storage practices

	n (%)

Farmworkers	**17**
Not within reach/not accessible	14 (82.4)
Within reach/accessible	3(17.6)
Students	**29**
Not within reach/not accessible	22(75.9)
Within reach/accessible	6(20.7)
Child is big - ones used by the toilet window and the rest in a cupboard. Those like I use when needed e.g., killing cockroaches or rats) I hide them in the storage room.	1(3.4)

In Table 14, in both the farmworker and student cohorts, majority (41.1% and 72.4% respectively) of the participants discarded their chemical and pesticide products in a household garbage/black bin. One farmworker said that the empty pesticide and container was disposed in the designated area on the farm for empty pesticide/chemical products.

Table 14

Participants empty container disposal practices (N=46)

	n (%)
Farmworkers	**17**
Discard it in household garbage/black bin.	7(41.1)
Re-use container/recycle it.	3(17.6)
Rinse and/or dispose in bin and/or recycle.	4(23.5)
Burn it	2(11.8)
Dispose in the designated area on the farm for empty pesticide/chemical products	1(5.9)
Students	**29**
Discard it in household garbage/black bin.	21(72.4)
Dispose through a recycling facility/follow instructions on how to dispose	3(10.3)
Re-use container/recycle it	2(6.9)
Burn it	1(3.4)
Recycle or throw-away	1(3.4)
Rinse and/or dispose in bin and/or recycle	1(3.4)
	46

3.6 Participants' responses on improving risk communication to protect children from chemical exposures

Among the farmworkers, the two themes were split almost evenly (23.5% answers related to social capital and 29.4% related to semiotics). An example that reflects the majority of the responses that fell within cultural capital is:

"Parents should teach the children at an earlier age/ teach children not to play with chemical".

Examples from the farmworkers responses that reflected semiotics are:

"I would be very careful about using kids ok with a picture on it. Many people can't read and then they just look at the picture"

"Print the words bigger"

"Set borders so as not to get them started"

Similar to the farmworkers, the two themes were split almost evenly amongst the students (48.3% answers related to social capital and 41.4% answers related to semiotics). Examples from the students' responses that reflected social capital were:

"Always educate the children at a young age about the dangers"

"Only to make parents, caregivers, guardians and children more aware of the dangers of the products we use (both on labels and in our 'communities'). Some of these products have been used for one to two generations and we have become so familiar with these brands in our households that we forget the real dangers these product possess".

Examples from the students' responses that reflected semiotics were:

"*The bigger and brighter the label, the better"*

"Not everyone can read English fluently so maybe trying to use other means of clearly relaying the message"

"Big warning signs"

"The warning labels must be unambiguous and very clear to read. They should also come with text"

"Printed on the front label not the back"

4. Discussion

Although household chemical risk and precautionary information is available on legally sold chemical packaging labels in South Africa (e.g., use of pictograms), this research found that there are potential varying factors (age, educational level, learned behaviors, occupational exposures, perception of danger) that could be barriers towards, and play a role in how this information is understood and used by caregivers, which in turn, could result in child exposure to hazardous chemicals. As the sample size of the study was small, the potential factors identified can be further research in future studies. Existing literature underpins many of the findings in this study, such as the theories on social capital by Pierre Bourdieu and semiotics by Charles Sanders Peirce. Additionally, the results that are discussed are themes that have emerged from the participants and therefore are important to consider for improving pictogram comprehensibility.

Important to note is that the study did not achieve the desired response rate of 105 participants as initially planned due to COVID-19. Thereafter, the study adjusted the sample size to 60 students and seventeen farmworkers (who were already completed face-to-face questionnaires before COVID-19 impacted South Africa). However, only 29 students were eligible to participate during the time of data collection. Therefore, the sample size was 46 participants. This however was lower than the anticipated response rate, therefore, impacts on the generalizability of the findings of the study, particularly for the quantitative results.

4.1 Factors impacting caregivers comprehension of label information

4.1.1 Impact of age on comprehensibility

A noticeable difference in the demographics of the participants in this study is that the farmworkers were older caregivers than the students. Therefore before beginning to explore the rest of the factors, age therefore could serve as a potential factor by itself, and could play a role in the life experiences and life stages of the caregiver's responses in this study. It is important to note that there is evidence that age can influence the comprehension of pictograms where, in particular, among elderly groups, there is greater difficulty in correctly comprehending the pictogram (Lesch et al 2011, Beaufils and Mondon, 2013, Liu and Ho, 2012). Therefore, generational differences attributed to age can have an overall impact on many of the study findings, such as a participant's ability to comprehend labels, which can be influenced by their different lived experiences and exposures in life.

4.1.2 Influence of different educational level of caregivers on comprehensibility

The study benchmarked the participant's definition of a label according to the scientific definition of a label as prescribed by the GHS handbook. It is important for people to understand the definition of a label as the GHS prescribes it, because the label is the main mechanism used by

the chemical and pesticides industry to convey information of their product to consumers (UN, 2019). Therefore, the study assessed whether there is a difference between what consumers and workers perceive the label to be, and the GHS intention of the label. The study found that child caregivers seemed to have an overall idea of what a label was (partially correct and correct answers were provided). However, participating students' ability to define the label differed from farmworkers as they provided more in depth responses that coincided with the scientific definition of a label. It is important to note that the majority of the participating farmworkers had an educational level lower than a high school certificate and that their responses to the question of defining a label was less detailed, in comparison to the students. This may be because students are more familiar with test question formats, which require in depth answers.

The findings indicate that the farmworkers were more aware of labels, as nearly all of them were able to provide accurate examples of where they had seen the labels before (e.g. seen on food products and household chemicals or pesticide products). This awareness of labels seemed greater than their ability to describe the label in depth, which may reveal their ability to express thoughts/knowledge in words. People with low literacy levels in particular may need assistance to understand written information on labels in order to implement the recommended health behavior (Houts *et al.,* 2006). According to Viswanathan (2011), people who find reading difficult, have a lower functional capacity for comprehension because they spend more effort on the process (e.g., word-level reading) than the information itself. Therefore, a notable finding to further explore is that varying levels of comprehension that could be associated with different education levels.

Though the majority of the overall study participants indicated that they read information on the chemical container, interestingly, in comparison to the students, some of the farmworkers noted that they would have asked shopkeepers on how to use the products. However, when the participants were asked in a follow up question if chemical labels provided enough information on the health effects and dangers associated with it, the difference of the results were nearly opposite between the students and farmworkers, as 55% agreed and 45% disagreed respectively. The aforementioned results are merely one example of the impact that suggested educational differences could have on comprehension of labels and pictograms.

Arguably, educational level could be a significant factor that influences this finding and should be taken into account when assessing the overall objective: comprehensibility. Though the results between educational level and label definitions were not statistically significant, it is important to note that when collapsing the partially correct into incorrect categories and running a chi-square test for association, the results were closer to statistical significance. To further support this, a similar study conducted with one hundred and seventy two farmworkers in India found a statistically significant association between farmworkers' educational status and their ability to interpret risk labels (Kautilya *et al.* 2016). Kautilya *et al*. (2016) argue that farmworkers who

have a better educational level are more likely to have correct interpretations of labels. The aforementioned research and findings of this study coincide with the suggestions of the farmworkers on chemical industries needing to provide educational talks on the farm about the dangers of chemicals. The results further suggest that pictograms should be as close as possible to a representation of the precautionary statement for people who cannot read and would depend entirely on the picture for information. However, when considering the design of pictograms, it is important that it is culturally appropriate too.

4.1.3 Learned behaviours and occupational exposure

The concept of cultural capital can be applied as it provides a link between why there are such varied understandings about the same construct (label). A major difference between farmworkers and students knowing if a chemical is dangerous was that farmworkers associated danger with sensory and physiological adverse reactions such as strong smell, coughing and/or a body rash whereas students associated dangers with more knowledge that they had attained from reading of the labels. Similarly research done nearly two decades ago shows farmworkers typically view exposure to pesticides with sensory (smell and taste) detection (Quandt *et al.,* 1998*,* Arcury *et al.,* 2002, Quandt *et al.,* 2006). In relation to the concept of cultural capital, learning should not only be bracketed into formal education (school, college, university), and instead, should extend into learning through the environment such as through occupational settings, community and residential settings, and social exchanges (García Peñalvo *et al.,* 2013). This is of interest as it highlights the differences in both the previous experiences of farmworkers and the education levels between the two groups. The assumption that students provided more theoretical responses may be due to their exposure to academic testing whilst farmworkers presented more sensorial and physiological responses aligned with their lived experiences –revealing a difference by occupation. This finding coincides with the relational aspect of cultural capital theory wherein individuals' experiences are used in society enabling them to interact in a way that is strategically driven (Tramonte and Willms, 2009). Another thought-provoking finding was that all five of the proposed GHS pictograms (shown in Appendix 2.1) made reference to behaviours that should be avoided rather than negative health outcomes that could occur should a child be exposed to a chemical, and awareness about these was low. Instead, and in addition to the precautionary statement "Keep out of reach of children", something alluding to negative health outcomes could be added to the design of the pictogram to increase comprehensibility. This would be an important change as the study showed that farmworkers were more likely to make references to health-related consequences of exposure.

As there was a considerable amount of varied understanding of the dangers of the products between the two study populations, a disproportionate, or at least, inequitable, amount of children could be accidentally poisoned within the various communities. Research suggests that informal

settlements and farm areas experience more environmental threats to health such as chemical poisoning among children than in suburbs or higher income communities, and therefore it is vital that comprehensibility is made more effective for all (Tolosana *et al*., 2009; WHO, 2010; Weimann and Oni, 2019).

4.2 Differences in the interpretations of the GHS pictograms

4.2.1 Existing Nine GHS pictograms (Table 5 and 9)

The purpose of having a harmonized classification and labeling system for chemicals is to provide a systematic global approach to identifying what the hazards of chemicals are, to attract users' attention to the hazards, and ultimately, enable users to take appropriate actions that will protect them from harm (Pratt, 2002). Pictograms are hazard communication mechanisms that aim to convey hazard information through visual, illustrative means (FAO, 2015). However, studies have shown that the comprehensibility of pictograms is a concern, particularly in LMICs and amongst populations with low literacy despite it being designed particularly to overcome literacy barriers (Dalvie, 2014; Adane *et al* 2012, Emery *et al* 2015, Rother, 2008). Similar findings were found in this study. For example, when child caregivers were asked to describe the nine existing GHS pictograms in their own words, farmworkers had a different overall understanding of what the pictograms meant than the students. The majority of the students associated pictogram 4 (Table. 5) with one of the three following categories: (1) "fatality", (2) "danger/toxic" and (3) "harmful to health". On the other hand, farmworkers' responses were much more varied with only the "danger" category receiving the most consensuses. Similarly, among farmworkers, only one associated pictogram 4 (Table. 5) with the "deadly" category whereas, in contrast, fifteen students responses were categorized as "deadly".

Child caregivers were then given the correct statements from the GHS that defines the pictograms and asked the degree to which the descriptions accurately described each pictogram. The data suggests that only two (pictogram 2 and 3) from the nine pictograms (Table 9) could have either a simpler definition or a more elaborate definition and the pictogram would still be understood by the majority of both groups (students and farmworkers). These results raise concern, as the end-users are not in control of the hazard communication that appears on their product labels. Though the GHS harmonization goal is to create a standard approach, the finding of the study where there was no consensus achieved in seven of the nine pictograms and there were varied inferences of the same pictogram, reveals that standardization is relative to individual characteristics. Therefore, when exposed to chemicals, it could be argued that their comprehension of the label information was in accordance to the study participants' individual characteristics. Rother (2018) argues that end-users cannot be held responsible for what is referred to as "misuse" of the product

when they are unable to comprehend the information and that the responsibility of appropriately communicating information should be legislated as chemical industry responsibility. Rother (2018) argues that end-users in LMICs do not fully comprehend the information on pesticide labels and therefore, are unable to fully mitigate the risk of the product. Furthermore, when caregivers do not have the scientifically intended understanding of the risks associated with chemical products, the risk of child hazardous exposures increases.

The study locations differed and included a diversity of participants who lived in different types of communities (students from suburbs and informal settlements, and farmworkers living on a farm). The difference in place of residence can also influence exposure risks merely because of the complex context of the living environments. Research shows that children, who either live on farms, or are within close proximity to farms on a daily basis, are at a higher risk to pesticide exposure and facing adverse health effects (Panuweta *et al.,* 2009; Rodrı´guez *et al.,* 2012; a Gonzalez *et al,* 2012). All the participating farmworkers used one or more chemical and pesticide products, which can lead to the potential exposure to household chemicals if not handled appropriately. Therefore, the varied understandings of labels and pictograms amongst participating farmworker caregivers can result in placing their children at greater risk of increased pesticide exposure than the students' children.

4.2.2 Proposed GHS pictogram that aims to protect children

The inclusion of the pictogram depicted in Table 7 is purposed so as to communicate the precautionary statement, "Keep out of reach of children" to reduce child exposures to hazardous chemicals. Current UN discussions revolve around five pictograms proposed by different stakeholders. Thus, assessing which of the five is best understood as intended, is key. This study found that despite the age, educational level, and place of residence differences between the study farmworkers and students, more than half chose pictogram 1 (Table 7). This is a notable finding that one pictogram in particular received the highest vote to communicate the same precautionary statement, and the majority of the participants had a similar reason for their choice, despite population differences. The participants reasoning for choosing pictogram 1 was related to the semiotic characteristics thereof. That is, participants found pictogram one most favorable as they believed the image illustrating the high placement of the product and a child that should not be able to reach it was clear. This finding is consistent with, and similar to, the findings of a review conducted on pictograms used in clinical practice including 86 participants where the preferred semiology of the pictogram category "Keep out of reach of children" was the defined outline of the toddler and the image of the toddler reaching out with a cross over it (Korenevsky *et al.,* 2013). Though the small sample size influenced the ability to create themes for the other four pictograms, the various ways in which the participants interpreted an image that is intended to

have one meaning highlights how comprehension differs among different population groups (Rother, 2018).

4.3 *The role of pictogram design (semiotics) and comprehensibility*

In a literature review on the topic of communicating risks to consumers, the authors concluded that risk communication practitioners should consider the context in which the message is presented as it may be relevant in predicting end-users' processing and interpretation of information (Visschers *et al.,*2009). An element of the pictogram where both farmworkers and students agreed upon was that the colour of pictograms drew their attention to looking at it. All the pictograms in the GHS have a black symbol, a white background and a red frame (UN,2019). In line with the issue of colour, this study found that a proportion of the farmworkers described a pictogram that is red to convey danger. The colour red is not a coincidence, a study conducted in Zambia similarly found that among different sectors (agricultural, industry, consumer, transport), particularly from the agricultural group, red is well associated with poison (Banda and Sichilongo, 2006). In relation to semiotic theory, it can be seen from the study that colour plays a role in increasing comprehension of symbols. According to Kauppinen-Räisänen and Jauffret (2017) colour meaning refers to what the end-users infer from a specific colour and what their interpretation of it is. The findings illustrated that colour played a role in the comprehensibility of pictograms and both groups, despite their different characteristics, preferred the current colours used by the GHS, particularly red. Researchers argued that based on their results of a study on GHS pictograms, simple graphic designs incorporating common shapes seen in daily life settings, are more discernible amongst people (Su and Hsu, 2007). The aforementioned is particularly useful as in the farmworker cohort, the majority of the participants preferred semiotics mechanisms to convey health risks versus social capital mechanisms.

4.4 Barriers towards comprehensibility and the right to information on hazardous substances

4.4.1 Label access

By law in South Africa, in order for chemical and pesticide products to be registered and legally sold, they need to contain the appropriate labeling. However, although this is legally required, there remains a market for the sale of illegal, unlabeled or incorrectly labeled, pesticides in South Africa (Rother, 2016). When looking at the data collected, almost all of the child caregivers indicated that they buy most of their chemical and pesticide products from grocery stores. However, a few of the child caregivers bought their products from informal venders (street sellers), highlighting that the barrier of lack of access to labels does exist, as pesticides sold at informal venders are often decanted into an unmarked bottle (Rother, 2010). Additionally from both the farmworker and student groups in the study, there were child caregivers who said only some of their products had labels on them, while others, had none. Based on these results, it

should be highlighted that not all people have access to a label, particularly those buying pesticides from street vendors. Street pesticides are a problem in many lower income communities in South Africa and are likely to be banned pesticides or agricultural pesticides that are decanted into unlabeled containers (Rother 2010).

Though the majority of the study participants did have access to a label, to note from other existing research, people buy pesticide products that have been decanted into containers with no labels on them (Lekei *et al.,* 2014; Williamson *et al.,* 2008; Rother 2010). Therefore, an important barrier towards pictogram comprehensibility and understanding information on proper handling of chemicals can be through the lack of exposure to a label. Dugger-Webster and LePrevost (2018) argues that by design, end-users should refer to the label on how to store and dispose the empty container. A concern that has been raised from the study results is the way in which participants disposed and stored chemical containers. The majority of the farmworkers and students disposed their empty chemical containers in their household garbage or black bin despite having a facility for appropriate disposal close in proximity to their houses. Similarly, only a few students reported that they take their empty chemical containers to a recycling facility. Additionally, the farmworkers recycle and re-use their empty chemical containers more in comparison to the students. London (2008) argued that when chemical containers, like empty pesticide containers are reused, the chemical residues inside can potentially poison people, including children.

Another way for children to be exposed to chemicals in their households is through their caregivers storing it in a place that is easily accessible to children (Yimaer *et al* (2017). A study conducted in Pakistan found that unintentional poisoning amongst children was more likely to take place in households where unsafe storage practices of chemicals were reported than in households with safely stored chemical products (Ahmed *et al.,* 2010). In contrast to the inappropriate disposal of the chemical container, a positive finding in relation to decreasing child exposure to chemical products is that overall caregivers in the study place their products out of reach of the child. The dangers associated with chemical storage practice and child poisoning, however, is an area for further research as Hassan *et al.,* 2019, argues that a small amount of epidemiological studies have been done on the practices of toxic substances such as chemicals in households where children live.

The findings illustrated that an area for improvement on chemical and pesticide labels can be to include a pictogram that focuses on elements of storage. Elements of a pictogram commonly suggested in the study to communicate danger was a red cross. A red cross could therefore be used when communicating storage practices. This however, coincides with the results where the pictogram chosen the most by both farmworkers and students, included a red cross over a cabinet.

4.4.2 Label information efficiency

A label can be seen as a tool, which is used to communicate risks, and hazards that are associated with the product (Rother, 2018). However, its efficiency should be dependent on whether the end-user is able to retrieve the relevant information to ultimately use the product appropriately as well as simultaneously protect their own and importantly, their children's health. The study shows that despite all the students acquiring information about the product from labels, nearly half felt that labels did not provide enough information about the health risks of the product. Rather, suggestions provided by students suggested that labels should have words that signal the specific health consequence associated with a specific risk. Similarly to the suggestions provided by students on adding more health specific information on labels, there is an ongoing global controversy that the pesticide industry does not adequately warn end-users regarding potential links between a specific herbicide (i.e., glyphosate) and cancer (Carvalho, 2020). The aforementioned pesticide product is widely used in countries such as the United States, Europe and South Africa, therefore end-users need the adequate information to be protected from exposure to the toxicity thereof. The consumer demand for more health information on glyphosate labelling is relevant for the finding of this study. In contrast to the students, where nearly half felt that the label did not provide enough information, the majority of the farmworkers indicated that it did. This, however, draws us towards the difference between words, which was emphasized throughout the study as a preference by the students (Table 12) and farmworkers preference for semiotics. Therefore, the study indicates that both wording and semiotics hold similar weight of importance when communicating risks to different people.

In this study, of interest was whether the pictograms are easily comprehensible by different groups. This study found that the educational level differences between the students (completing tertiary education) in comparison to the farmworkers (secondary education and below) were apparent. The students could describe pictures in depth and accurately in line with the precautionary statement, whereas the farmworkers struggled to put into words a picture that matches the statement. This finding is relevant as it indicates the pictogram design needs to be as close as possible to the precautionary statement to provide a visual cue to what the precautionary statement intends to communicate. Many studies (Braich et al., 2011; Damalas and Khan, 2016; Dowse and Ehlers, 2001; Rother 2008; Waichmana et al., 2007) have been conducted on the comprehensibility of chemical product pictograms and labels among low literacy groups. However, this study is different to those that come before it as incorporates a perspective of a high literacy group together with lower literacy groups and shows both the similarities and differences in their pictogram comprehensions.

In comparison to other research on the comprehension of pictograms (Braich et al., 2011; Damalas and Khan, 2016; Dowse and Ehlers, 2001; Rother 2008; Waichmana et al., 2007), none focused on the new Child pictogram. Therefore, novel to this research was that it had a focus on the comprehension of the proposed GHS pictogram, "Keep out of reach of children" among

caregivers living in a LMIC context.

4. 5 *Limitations and implications for future research*

Though yielding interesting results, there were some limitations in this study. Firstly, the global pandemic, COVID-19 took place during the time of data collection. Therefore, only two study locations out of three could be included in this study, resulting in less diversity in participants as initially desired and a smaller sample size. The small sample size was particularly a limitation for analyzing the quantitative data as it resulted in a low statistical power when using the statistical test, Chi-square.

5. Conclusion

Based on the responses from the participants in this study, there are clear distinctions in the preference of how industry should communicate the dangers associated with chemicals products with end-users. Therefore, though mechanisms like labels and pictograms are designed and informed by chemical experts in the field, it should not be presumed that it is sufficient to transcend cultural, age, living experiences, quality of education and environmental differences that exist in communities.

Though realistically difficult to implement, it is recommended that chemical industry and LMICs chemical legislators take into account what individuals classify as communicating danger (e.g., farmworkers choice of a fire and sensory indicators of harm: rash, cough, strong smell) and health hazards. The experiences of people and their recommendation should be incorporated into chemical safety information on labels. Additionally, it was seen that participants have preferred semiotics that could similarly be embraced. This recommendation is to encourage a bottom-up approach by getting end-users more involved when considering how pictograms should be designed in order to overcome literacy barriers. It is thus important that pictograms not only be designed according to semiotic principles but also following the design, it is important to test comprehensibility in the targeted population to ensure that health risks are reduced, especially for children. A requirement for chemical policy on the labeling of products should be that the label has received considerable amount of input from non-experts and end-users from different backgrounds.

Though pictograms and labels play an essential role, it is not the answer to reducing children's exposure to toxic chemical household products. Rather, it is encouraged that alternative products to chemicals be campaigned for and made easily accessible to consumers, particularly those living in low-income households. As seen in the responses on the household and chemical products used by all participants in this study, children are faced with daily risk of being exposed merely by the products being either used daily or stored within their reach. Therefore, the unavoidable risk of poisoning should be minimized through chemical products being exchanged

for natural and alternative products that have little to no risk.

Declaration of competing interest

The authors report no declarations of interest.

Acknowledgements

This project received no funding.

References:

Ahmed, B., Fatmi, Z., Siddiqui, A.R. and Sheikh, A.L., 2011. Predictors of unintentional poisoning among children under 5 years of age in Karachi: a matched case–control study. *Injury prevention*, *17*(1), pp.27-32.

Arcury, T.A., Quandt, S.A. and Russell, G.B., 2002. Pesticide safety among farmworkers: perceived risk and perceived control as factors reflecting environmental justice. *Environmental Health Perspectives*, *110*(suppl 2), pp.233-240.

Andrade-Rivas, F., & Rother, H. A. (2015). Chemical exposure reduction: Factors impacting on South African herbicide sprayers' personal protective equipment compliance and high risk work practices. *Environmental research*, *142*, 34-45.

Adane, L., & Abeje, A. (2012). Assessment of familiarity and understanding of chemical hazard warning signs among university students majoring chemistry and biology: a case study at Jimma University, Southwestern Ethiopia. *World Applied Sciences Journal*, *16*(2), 290-299.

Adeyonu, A.G., Akpor, O.B., Oluba, O.M., Soyombo, A.J., Alabi, O.O. and Alayemola, A. (2019). Agricultural Pesticides: Children's Health in Jeopardy–A Review. *5 (2), 60-64*

Airhihenbuwa, C. O., & Webster, J. D. (2004). Culture and African contexts of HIV/AIDS prevention, care and support. *Sahara-J: Journal of Social Aspects of HIV/AIDS*, *1*(1), 4-13.

American Academy of Pediatrics Council on Environmental Health, 2012. Pesticide Exposure in Children. *Pediatrics, 130 (6) e1757-e1763.*

Banda, S.F. and Sichilongo, K., 2006. Analysis of the level of comprehension of chemical hazard labels: a case for Zambia. *Science of the total Environment*, *363*(1-3), pp.22-27.

Berthenet, M., Vaillancourt, R. and Pouliot, A., 2016. Evaluation, modification, and validation of pictograms depicting medication instructions in the elderly. *Journal of Health Communication*, *21*(sup1), pp.27-33.

Barros, I.M., Alcântara, T.S., Mesquita, A.R., Santos, A.C.O., Paixão, F.P. and Lyra Jr, D.P., 2014. The use of pictograms in the health care: a literature review. *Research in Social and Administrative Pharmacy*, *10*(5), pp.704-719.

Beaufils, E., Hommet, C., Brault, F., Marqué, A., Eudo, C., Vierron, E., De Toffol, B., Constans, T. and Mondon, K., 2014. The effect of age and educational level on the cognitive processes used to comprehend the meaning of pictograms. *Aging clinical and experimental research*, *26*(1), pp.61-65.

Braich, P.S., Almeida, D.R., Hollands, S. and Coleman, M.T., 2011. Effects of pictograms in educating 3 distinct low-literacy populations on the use of postoperative cataract medication. *Canadian journal of Ophthalmology*, *46*(3), pp.276-281.

Damalas, C.A. and Khan, M., 2016. Farmers' attitudes towards pesticide labels: implications for personal and environmental safety. *International Journal of Pest Management*, *62*(4), pp.319-325.

Dowse, R. and Ehlers, M.S., 2001. The evaluation of pharmaceutical pictograms in a low-literate South African population. *Patient education and counseling*, *45*(2), pp.87-99.

Charman, A., Petersen, L. and Piper, L., 2012. From local survivalism to foreign entrepreneurship: the transformation of the spaza sector in Delft, Cape Town. *Transformation: Critical Perspectives on Southern Africa*, *78*(1), pp.47-73.

Chebelyon-Dalizu, L., Garbowitz, Z., Hause, A. and Thomas, D., 2010. Strengthening spaza shops in Monwabisi Park, Cape Town. *BSc qualifying project, Faculty of Worcester, Polytechnic Institute, Cape Town*.

Carrillo, E., Fiszman, S., Lähteenmäki, L. and Varela, P., 2014. Consumers' perception of symbols and health claims as health-related label messages. A cross-cultural study. *Food Research International*, *62*, pp.653-661.

Carvalho, F.P., 2020. Glyphosate, the herbicide that become a nightmare and the Precautionary Principle. *International Journal of Environmental Studies*, pp.1-12.

Clark, H., Coll-Seck, A.M., Banerjee, A., Peterson, S., Dalglish, S.L., Ameratunga, S., Balabanova, D., Bhan, M.K., Bhutta, Z.A., Borrazzo, J. and Claeson, M., 2020. A future for the world's children? A WHO–UNICEF–Lancet Commission. *The Lancet*, *395*(10224), pp.605-658.

Coker, E., Chevrier, J., Rauch, S., Bradman, A., Obida, M., Crause, M., Bornman, R. and Eskenazi, B., 2018. Association between prenatal exposure to multiple insecticides and child body weight and body composition in the VHEMBE South African birth cohort. *Environment international*, *113*, pp.122-132.

Chemical Pro Safety. GHS in South Africa. Available: https://www.chemsafetypro.com/Topics/South_Africa/GHS_in_South_Africa.html [2020, February 15].

Dalvie, M.A., Africa, A., Solomons, A., London, L., Brouwer, D. and Kromhout, H., 2009. Pesticide exposure and blood endosulfan levels after first season spray amongst farmworkers in the Western Cape, South Africa. *Journal of Environmental Science and Health Part B*, *44*(3), pp.271-277.

Dalvie, M.A., Rother, H.A. and London, L., 2014. Chemical hazard communication comprehensibility in South Africa: Safety implications for the adoption of the globally harmonised system of classification and labelling of chemicals. *Safety science*, *61*, pp.51-58.

Dugger-Webster, A. and LePrevost, C.E., 2018. Following pesticide labels: A continued journey toward user comprehension and safe use. *Current Opinion in Environmental Science & Health*, *4*, pp.19-26.

Gonzalez, V., Huen, K., Venkat, S., Pratt, K., Xiang, P., Harley, K.G., Kogut, K., Trujillo, C.M., Bradman, A., Eskenazi, B. and Holland, N.T., 2012. Cholinesterase and paraoxonase (PON 1) enzyme activities in Mexican–American mothers and children from an agricultural community. *Journal of exposure science & environmental epidemiology*, *22*(6), pp.641-648.

García Peñalvo, F.J., Conde González, M.Á., Zangrando, V., García Holgado, A., Seoane Pardo, A.M., Alier Forment, M., Galanis, N., López, J., Griffiths, D., Johnson, M. and Marques, M.A., 2013. Tagging, Recognition, Acknowledgment of Informal Learning experiences (TRAILER).

Sabarwal, A., Kumar, K. and Singh, R.P., 2018. Hazardous effects of chemical pesticides on human health–Cancer and other associated disorders. *Environmental toxicology and pharmacology*, *63*, pp.103-114.

Frederiks, C. and Wesseler, J.H., 2019. A comparison of the EU and US regulatory frameworks for the active substance registration of microbial biological control agents. *Pest management science*, *75*(1), pp.87-103.

Fertilisers, Farm Feeds, Agricultural Remedies and Stock Remedies Act 36 of 1947. Available: https://www.nrwdi.org.za/file/Act%2015%20of%201973.pdf [2020, August 1].

Gomes, H.D.O., Menezes, J.M.C., da Costa, J.G.M., Coutinho, H.D.M., Teixeira, R.N.P. and do Nascimento, R.F., 2020. Evaluating the presence of pesticides in bananas: An integrative review. *Ecotoxicology and Environmental Safety*, *189*, p.110016.

United Nations., 2019. Globally Harmonized System of Labelling and Classification of Chemicals (GHS)

Hazardous Substances Act, 1973. 1973. Available: https://www.gov.za/documents/fertilizers-farm-feeds-seeds-and-remedies-act-28-may-2015-1101 [2020, August 1].

Handford, C.E., Elliott, C.T. and Campbell, K., 2015. A review of the global pesticide legislation and the scale of challenge in reaching the global harmonization of food safety standards. *Integrated environmental assessment and management*, *11*(4), pp.525-536.

Houts, P.S., Doak, C.C., Doak, L.G. and Loscalzo, M.J., 2006. The role of pictures in improving health communication: a review of research on attention, comprehension, recall, and adherence. *Patient education and counseling*, *61*(2), pp.173-190.

Kauppinen-Räisänen, H. and Jauffret, M.N., 2018. Using colour semiotics to explore colour meanings. *Qualitative Market Research: An International Journal. 21 (1), 101-117.*

Kheir, N., Awaisu, A., Radoui, A., El Badawi, A., Jean, L. and Dowse, R., 2014. Development and evaluation of pictograms on medication labels for patients with limited literacy skills in a culturally diverse multiethnic population. *Research in Social and Administrative Pharmacy*, *10*(5), pp.720-730.

Kautilya, V., Hegde, S., Chendrashekaran, P. and Begum, K., 2016. A cross-sectional survey on the awareness of pesticide labels and pesticide safety pictograms among paddy farming in south India. *Journal of Health Sciences & Surveillance System*, *4*(4), pp.158-166.

Klaschka, U. and Rother, H.A., 2013. 'Read this and be safe!'Comparison of regulatory processes for communicating risks of personal care products to European and South African consumers. *Environmental Sciences Europe*, *25*(1), p.30.

Korenevsky, A., Vaillancourt, R., Pouliot, A., Revol, M., Steed, E., Besançon, L., Wahrendorf, M.S. and Patel, J.R., 2013. How many words does a picture really tell? Cross-sectional descriptive study of pictogram evaluation by youth. *The Canadian Journal of Hospital Pharmacy*, *66*(4), p.219.

Landrigan, P.J. and Goldman, L.R., 2011. Children's vulnerability to toxic chemicals: a challenge and opportunity to strengthen health and environmental policy. *Health Affairs*, *30*(5), pp.842-850.

London, L., Beseler, C., Bouchard, M.F., Bellinger, D.C., Colosio, C., Grandjean, P., Harari, R., Kootbodien, T., Kromhout, H., Little, F. and Meijster, T., 2012. Neurobehavioral and neurodevelopmental effects of pesticide exposures. *Neurotoxicology*, *33*(4), pp.887-896.

Lekei, E.E., Ngowi, A.V. and London, L., 2014. Farmers' knowledge, practices and injuries associated with pesticide exposure in rural farming villages in Tanzania. *BMC public health*, *14*(1), p.389.

Mokhele, T.A., 2011. Potential health effects of pesticide use on farmworkers in Lesotho. *South African Journal of Science*, *107*(7-8), pp.29-35.

Nöth, W., 2012. Charles S. Peirce's Theory of Information: A Theory of the Growth of Symbols and of Knowledge. *Cybernetics and Human Knowing*, *19*(1-2).

Pearce, N., 2012. Classification of epidemiological study designs. *International journal of epidemiology*, *41*(2), pp.393-397.

Pinxten, W. and Lievens, J., 2014. The importance of economic, social and cultural capital in understanding health inequalities: using a Bourdieu-based approach in research on physical and mental health perceptions. *Sociology of health & illness*, *36*(7), pp.1095-1110.

Pratt, I.S., 2002. Global harmonisation of classification and labelling of hazardous chemicals. *Toxicology letters*, *128*(1-3), pp.5-15.

Panuwet, P., Prapamontol, T., Chantara, S. and Barr, D.B., 2009. Urinary pesticide metabolites in school students from northern Thailand. *International journal of hygiene and environmental health*, *212*(3), pp.288-297.

Quandt, S., Arcury, T., Austin, C. and Saavedra, R., 1998. Farmworker and farmer perceptions of farmworker agricultural chemical exposure in North Carolina. *Human Organization*, *57*(3), pp.359-368.

Quandt, S.A., Hernández-Valero, M.A., Grzywacz, J.G., Hovey, J.D., Gonzales, M. and Arcury, T.A., 2006. Workplace, household, and personal predictors of pesticide exposure for farmworkers. *Environmental health perspectives*, *114*(6), pp.943-952.

Rodríguez, T., de Joode, B.V.W., Lindh, C.H., Rojas, M., Lundberg, I. and Wesseling, C., 2012. Assessment of long-term and recent pesticide exposure among rural school children in Nicaragua. *Occupational and environmental medicine*, *69*(2), pp.119-125.

Rauh, V.A., Perera, F.P., Horton, M.K., Whyatt, R.M., Bansal, R., Hao, X., Liu, J., Barr, D.B., Slotkin, T.A. and Peterson, B.S., 2012. Brain anomalies in children exposed prenatally to a common organophosphate pesticide. *Proceedings of the National Academy of Sciences*, *109*(20), pp.7871-7876.

Rother, H.A., 2016. Pesticide vendors in the informal sector: trading health for income. *New Solutions: A Journal of Environmental and Occupational Health Policy*, *26*(2), pp.241-252.

Rother, H.A., 2010. Falling through the regulatory cracks: street selling of pesticides and poisoning among urban youth in South Africa. *International journal of occupational and environmental health*, *16*(2), pp.183-194.

Rother, H.A., 2018. Pesticide labels: Protecting liability or health?–Unpacking "misuse" of pesticides. *Current Opinion in Environmental Science & Health*, *4*, pp.10-15.\

Rother, H. A. (2008). South African farmworkers' interpretation of risk assessment data expressed as pictograms on pesticide labels. *Environmental research*, *108*(3), 419-427.

Su, T.S. and Hsu, I.Y., 2008. Perception towards chemical labeling for college students in Taiwan using Globally Harmonized System. *Safety science*, *46*(9), pp.1385-1392.

Snipes, S.A., Thompson, B., O'Connor, K., Shell-Duncan, B., King, D., Herrera, A.P. and Navarro, B., 2009. "Pesticides protect the fruit, but not the people": using community-based ethnography to understand farmworker pesticide-exposure risks. *American journal of public health*, *99*(S3), pp.S616-S621.

Tack, J., Carbone, F., Holvoet, L., Vanheel, H., Vanuytsel, T. and Vandenberghe, A., 2014. The use of pictograms improves symptom evaluation by patients with functional dyspepsia. *Alimentary pharmacology & therapeutics*, *40*(5), pp.523-530.

Tolosana, S., Rother, H.A. and London, L., 2009. Child's play: Exposure to household pesticide use among children in rural, urban and informal areas of South Africa. *South African Medical Journal*, *99*(3).

Viswanathan, M., Hastak, M. and Gau, R., 2009. Understanding and facilitating the usage of nutritional labels by low-literate consumers. *Journal of Public Policy & Marketing*, *28*(2), pp.135-145.

Visschers, V.H., Meertens, R.M., Passchier, W.W. and De Vries, N.N., 2009. Probability information in risk communication: a review of the research literature. Risk Analysis: An International Journal, 29(2), pp.267-287.

Vigoroso, L., Caffaro, F., Micheletti Cremasco, M., Bagagiolo, G. and Cavallo, E., 2019. Comprehension of safety pictograms affixed to agricultural machinery among Pakistani migrant farmworkers in Italy. *Journal of agromedicine*, pp.1-14.

World Health Organization, 2019. *Preventing disease through healthy environments: exposure to highly hazardous pesticides: a major public health concern* (No. WHO/CED/PHE/EPE/19.4. 6). World Health Organization.

World Health Organization, 2015. International code of conduct on pesticide management: guidelines on pesticide legislation.

World Health Organization, 2010. Environment and Health Risks: A Review of the Influence and Effects of Social Inequalities.

World Health Organization, 2016. The public health impact of chemicals: knowns and unknowns (No. WHO/FWC/PHE/EPE/16.01). World Health Organization.

Williamson, S., Ball, A. and Pretty, J., 2008. Trends in pesticide use and drivers for safer pest management in four African countries. *Crop protection*, *27*(10), pp.1327-1334.

Wohlfahrt-Veje, C., Main, K. M., Schmidt, I. M., Boas, M., Jensen, T. K., Grandjean, P., ... & Andersen, H. R. (2011). Lower birth weight and increased body fat at school age in children prenatally exposed to modern pesticides: a prospective study. *Environmental Health*, *10*(1), 79.

Weimann, A. and Oni, T., 2019. A Systematised Review of the Health Impact of Urban Informal Settlements and Implications for Upgrading Interventions in South Africa, a Rapidly Urbanising Middle-Income Country. International Journal of Environmental Research and Public Health, 16(19), p.3608.

Winder, C., Azzi, R. and Wagner, D., 2005. The development of the globally harmonized system (GHS) of classification and labelling of hazardous chemicals. *Journal of hazardous materials*, *125*(1-3), pp.29-44.

Yimaer, A., Chen, G., Zhang, M., Zhou, L., Fang, X. and Jiang, W., 2017. Childhood pesticide poisoning in Zhejiang, China: a retrospective analysis from 2006 to 2015. *BMC public health*, *17*(1), p.602.

Zeliger, H.I., 2013. Exposure to lipophilic chemicals as a cause of neurological impairments, neurodevelopmental disorders and neurodegenerative diseases. *Interdisciplinary toxicology*, *6*(3), pp.103-110.

PART C APPENDICES

Appendixes

Appendix 1.1 English Consent form

Student: Tatum Louw
Student number: LWXTAT001
University Supervisor: Professor Hanna-Andrea Rother
Place of study: University of Cape Town: Health Science faculty

---

Informed Consent to be a Voluntary Participant in the Research Study

Survey number

Research Topic: Analyzing hazard communication mechanisms to reduce health risks from child exposures to chemicals in South Africa.

Read to respondent:

Hello, my name is Tatum Louw and I am a Master of Public Health student at the **University of Cape Town (UCT)**. As a part of my course, a mini-dissertation is required. For my mini dissertation, I am conducting research on how the information on pesticide labels is understood. The purpose of this interview is to see what you think of the pictograms used on labels I would like to ask your permission to interview you as a participant in this study. The interview will be approximately 30-35 minutes long. There are no right and wrong answers however; your thoughts will help to inform improving chemical and pesticide labeling.

In this study, a ***pictogram*** refers to graphic symbols that serve the purpose of communicating information relating to the hazards associated with a chemical in a product (United Nations, 2009),

In this study, ***pesticides*** refer to **chemicals bought from shops or from informal vendors to kill pests.**

This interview is confidential. Only the researchers will see your answers, which will not be linked to your name. No one connected with you will see the answers you give. Please note that

some of these questions may be of a personal nature. **Your participation is voluntary**, which means that you can refuse to participate, and you can stop the interview at any time.

Your honesty in answering the questions will be valued by the researcher in order to enhance the learning experience of research. If you do not understand a question, please ask me to repeat it or explain it. **The interview should take 20-30 minutes.**

I will read out the questionnaire to you, give you a laminated sheet with pictograms on, and type in your responses to the questions asked on the electronic questionnaire on a laptop.

If you have any questions or want further information about the study, please contact the **Principal Investigator** or chair of UCT's ethics committee:

Prof. Andrea Rother
Division of Environmental Health
School of Public Health and Family Medicine
University of Cape Town
Anzio Rd., Observatory 7925
T: (+27) 21 404 7661; e-mail: environmentalhealth@uct.ac.za

If you have any questions regarding your **rights and welfare** as participants, please contact the **UCT's Faculty of Health Sciences Human Research Ethics Committee:**

Shuretta Thomas
Human Research Ethics Committee Administrator
Faculty of Health Sciences, University of Cape Town, E52, Room 24, Old Main Building, Groote Schuur Hospital, Observatory, Cape Town, South Africa
Tel. (+27) 21 406 6338; e-mail: shuretta.thomas@uct.ac.z

I understand the information read to me about participation and agree to being interviewed.

Yes No (circle)

I agree to participate in this study.

Yes No (circle)

Name of participant (print in block letters)
Signature

Date:

Interviewer's name (print in block letters)
Signature

Date:

Appendix 1.2 Afrikaans Consent form

Student: Tatum Louw
Studentenommer: LWXTAT001
Universiteitsbegeleier: Professor Hanna-Andrea Rother
Studieplek: Universiteit van Kaapstad: Fakulteit Gesondheidswetenskappe

Ingeligte toestemming om 'n vrywillige deelnemer aan die navorsingstudie te wees.

Opname nomm

Navorsingsonderwerp: Die ontleding van gevare-kommunikasiemeganismes om gesondheidsrisiko's van blootstelling aan kinders aan chemikalieë in Suid-Afrika te verminder.

Lees aan respondent:
Hallo, my naam is Tatum Louw en ek is 'n meester in openbare gesondheidstudent aan die Universiteit van Kaapstad (UK). 'N Deel van my kursusvereistes is dat ek navorsing doen oor hoe die inligting op etikette met plaagdoders verstaan word. Ek wil u toestemming vra om 'n onderhoud met u as deelnemer aan hierdie studie te voer. Die doel van hierdie onderhoud is om te sien wat u dink van die piktogramme wat op etikette gebruik word. Die onderhoud duur ongeveer 45 tot 45 minute. Daar is geen regte en verkeerde antwoorde nie, maar u gedagtes sal u help om chemiese en plaagdodermerkings te verbeter.

In hierdie studie verwys 'n **piktogram** na grafiese simbole wat die doel dien om inligting oor die gevare wat met 'n chemiese stof in 'n produk verband hou, oor te dra (Verenigde Nasies, 2009),

In hierdie studie verwys **plaagdoders** na chemikalieë wat by winkels of informele verkopers gekoop word om plae dood te maak.

Hierdie onderhoud is vertroulik. Slegs die navorsers sal u antwoorde sien wat nie aan u naam gekoppel is nie. Niemand verbonde aan u sal die antwoorde sien wat u gee nie. Let daarop dat sommige van hierdie vrae van persoonlike aard kan wees. U deelname is vrywillig, wat beteken dat u kan weier om deel te neem, en u kan die onderhoud te eniger tyd stop.

U eerlikheid in die beantwoording van die vrae sal deur die navorser gewaardeer word om die leerervaring van navorsing te verbeter. As u nie 'n vraag verstaan nie, vra my dan om dit te herhaal of te verduidelik. Die onderhoud behoort 20 - 30 minute te duur.

Ek sal die vraelys aan u voorlees, u 'n gelamineerde vel met piktogramme gee en u antwoorde op die vrae wat op die elektroniese vraelys gevra word op 'n skootrekenaar invoer.

As u enige vrae het of meer inligting oor die studie wil hê, kontak die Hoofondersoeker of voorsitter van die UK se etiekkomitee:
Prof. Andrea Rother

Afdeling Omgewingsgesondheid
Skool vir Openbare Gesondheid en Gesinsgeneeskunde
Universiteit van Kaapstad
Anzio Rd., Sterrewag 7925
T: (+27) 21 404 7661; e-pos: Environmentalhealth@uct.ac.za
Open in Google Translate
Feedback
Web results

As u vrae het oor u regte en welsyn as deelnemers, kontak die UK se Fakulteit Gesondheidswetenskappe se Etiekkomitee vir menslike navorsing:
Shuretta Thomas
Administrateur van die Komitee vir Menslike Navorsingsetiek
Fakulteit Gesondheidswetenskappe, Universiteit van Kaapstad, E52, Kamer 24, Ou Hoofgebou, Groote Schuur-hospitaal, Sterrewag, Kaapstad, Suid-Afrika
Tel. (+27) 21 406 6338; e-pos: shuretta.thomas@uct.ac.za

Ek verstaan die inligting wat oor deelname aan my voorgelees is, en stem saam om onderhoude te voer.

Ja Nee (sirkel)

Ek stem in om aan hierdie studie deel te neem.

Ja Nee (sirkel)

Naam van die deelnemer (druk in drukskrif)
Handtekening

Datum:

Naam van die onderhoudvoerder (druk in drukskrif)
Handtekening

Datum:

Appendix 1.3 Online consent form

Student: Tatum Louw
Student number: LWXTAT001
University Supervisor: Professor Hanna-Andrea Rother
Place of study: University of Cape Town: Health Science faculty

Informed Consent to be a Voluntary Participant in the Research Study

Research Topic: Analyzing hazard communication mechanisms to reduce health risks from child exposures to chemicals in South Africa.

Hello, my name is Tatum Louw and I am a Master of Public Health student at the **University of Cape Town (UCT)**. As a part of my MPH course, a mini dissertation is required for submission. Therefore, I am conducting research on how information on chemical or pesticide labelling is understood. The purpose of this survey is to see what you think of the pictograms used on labels. I would like to ask your permission to partake in this online survey and enrol you as a participant in this study. The survey will be approximately **15-20 minutes** long. There are no right and wrong answers however; your thoughts will help to inform improving chemical and pesticide labelling.

In this study, a ***pictogram*** refers to graphic symbols that serve the purpose of communicating information relating to the hazards associated with a chemical in a product (United Nations, 2009).

In this study, ***pesticides*** refer to **chemicals bought from shops or from informal vendors to kill pests.**

This survey is confidential. Only the researchers will see your answers, which will not be linked to your name. No one connected with you will see the answers you give. Please note that some of these questions may be of a personal nature. **Your participation is voluntary**, which means that you can refuse to participate, and you can stop the interview at any time. **Your honesty in answering the questions will be valued by the researcher in order to enhance the learning experience of research.**

If you have any questions or want further information about the study, please contact the **Principal Investigator** or chair of UCT's ethics committee:

Prof. Andrea Rother
Division of Environmental Health
School of Public Health and Family Medicine
University of Cape Town
Anzio Rd., Observatory 7925
T: (+27) 21 404 7661; e-mail: environmentalhealth@uct.ac.za

If you have any questions regarding your **rights and welfare** as participants, please contact the **UCT's Faculty of Health Sciences Human Research Ethics Committee:**

Shuretta Thomas
Human Research Ethics Committee Administrator
Faculty of Health Sciences, University of Cape Town, E52, Room 24, Old Main Building, Groote Schuur Hospital, Observatory, Cape Town, South Africa
Tel. (+27) 21 406 6338; e-mail: shuretta.thomas@uct.ac.za

Appendix 2.1 Lamination sheet with pictograms

Student: Tatum Louw
Student number: LWXTAT001
University Supervisor: Professor Hanna-Andrea Rother
Place of study: University of Cape Town: Health Science faculty

Pictograms referring to “Keep out of reach of children”

1

2

3

4

5

Appendix 2.2 Lamination sheet 2 with pictograms

Student: Tatum Louw
Student number: LWXTAT001
University Supervisor: Professor Hanna-Andrea Rother
Place of study: University of Cape Town: Health Science faculty

9 existing GSH pictograms

1	2	3

4	5	6

7	8	9

Appendix 3 English questionnaire

Face-to-Face administered questionnaire that will be uploaded on CommCare HQ

Student: Tatum Louw
Student number: LWXTAT001
University Supervisor: Professor Hanna-Andrea RoUniversity of Cape Town: Health Science faculty

---

Circle the answer the answers below that are the MOST applicable.

SECTION A DEMOGRAPHIC INFORMATION

1.What is your age?

- ☐ 18 – 23
- ☐ 24 – 29
- ☐ 30-35
- ☐ 36 – 41
- ☐ 42 – 47
- ☐ 48 – 54
- ☐ 55 – 60
- ☐ 61 +

2. What is your gender?

- ☐ Male
- ☐ Female
- ☐ Other

3. 1 What is your home language?

- ☐ English
- ☐ Afrikaans
- ☐ Isi-Xhosa
- ☐ Zulu
- ☐ Other

3.2 What language do you read in?

- ☐ English
- ☐ Afrikaans
- ☐ Isi-Xhosa
- ☐ Zulu

☐ Other

4.Area in which participant resides in:

☐ Paarl
☐ Khayelitsha
☐ Gugulethu
☐ Langa
☐ Nyanga
☐ University of Cape Town surrounding areas
☐ Northern Suburbs
☐ Outside of Cape Town

5.Type of dwelling participant resides in:

☐ In an informal settlement /township
☐ On a farm
☐ In a suburb

6. Are you currently?

☐ Full time employed
☐ Unemployed
☐ Student
☐ Part-time employed
☐ Seasonally employed

7. What is your highest qualification obtained?

☐ Passed 5-7
☐ Passed grade 8- 9
☐ Passed grade 10 - 11
☐ Matric Certificate
☐ Certificate
☐ Bachelor's Degree
☐ Honours Degree OR Postgrad diploma
☐ Master's Degree
☐ Doctoral Degree
☐ Post doctoral

SECTION B AWARENESS OF CHEMICALS AND LABELS

8.1Describe in your own words what you think a "label" found on a product is for:

8.2 Give an example of label you have seen or read recently:

8.3.1 List the different chemical products you use for cleaning purposes (Pictures 27-33 below are examples of the type products used and are not brand-specific).

☐	Washing powder
☐	Disinfecting bleach
☐	Whitening bleach
☐	Drain cleaner
☐	Paraffin
☐	Toilet cleaner
☐	Air fresheners

8.3.2 List the different chemical products you use for killing pest in your household? (Pictures 1 - 13 below and 14- 26 from pictures in previous question):

☐	Unmarked Street pesticide product
☐	Street pesticide with label on
☐	Commercial product (rodenticide)
☐	Commercial product (insecticide)

8.4 How do you know when a chemical or pesticide is dangerous for children's health?

SECTION C COMPREHENSION OF PICTOGRAMS

9. I am going to show you some pictures called pictograms that could be on chemical or pesticide label. I will then ask you questions on it.

9.1 Looking at the 5 pictograms, which one do you think best describes, "Keep out of reach of children"

☐	1
☐	2
☐	3
☐	4
☐	5

9.2 Please explain to me your answer to question 9.1 and why the pictogram you chose is the best?

10. Below are examples of chemical labels with pictograms. Questions 10. 1 -10.2 will be based on pictograms found on chemical labels; you can say whether you agree or disagree or if you are not sure.

	I agree	Not sure	I disagree
10.1 The COLOUR of the pictogram draws my attention to looking at it	[1]	[2]	[3]
10.2 The SIZE of the pictogram draws my attention to looking at it	[1]	[2]	[3]

11. I am going to show you some pictures called pictograms that is already found on chemical or pesticide label. I will then ask you questions on it. .

11.1.For the following pictograms below, which ones have you seen before on a chemical label before (e.g.,, jik, toilet cleaner, washing powder, paraffin). You can choose more than one option. You can choose more than one option.

	1
	2
	3
	4
	5
	6
	7
	8
	9

11.2 What does each pictogram mean to you (from 1 to 9)?

12.1 If you could label a chemical product as dangerous, what pictogram would you use to show danger?

12.2 What do you think is a good pictogram that will show you a chemical product is harmful to your health?

12.3 What do you think is a good pictogram that will show you a chemical product is harmful to children's health?

SECTION D BARRIERS TOWARDS COMPREHENSIBILITY:

13. Access to chemical labels and label information

13.1. Does the chemical products you use have labels on them? (show point chart for participants to see the products they use)

- [ ] Yes all have labels.
- [ ] No all does not have labels.
- [ ] Some has labels.
- [ ] Not sure

13.2 Looking at the point chart with the nine pictograms and their definitions, do you feel the word describing the pictograms increases your understanding of it?

13.2.1 Pictogram 1

- [ ] Yes
- [ ] No
- [ ] Partially
- [ ] Don't know

13.2.2 Pictogram 2

- [ ] Yes
- [ ] No
- [ ] Partially
- [ ] Don't know

13.2.3 Pictogram 3

- [ ] Yes
- [ ] No
- [ ] Partially
- [ ] Don't know

13.2.4 Pictogram 4

- [ ] Yes
- [ ] No
- [ ] Partially
- [ ] Don't know

13.2.5 Pictogram 5

- [ ] Yes
- [ ] No

☐ Partially
☐ Don't know

13.2.6 Pictogram 6

☐ Yes
☐ No
☐ Partially
☐ Don't know

13.2.7 Pictogram 7

☐ Yes
☐ No
☐ Partially
☐ Don't know

13.2.8 Pictogram 8

☐ Yes
☐ No
☐ Partially
☐ Don't know

13.2.9 Pictogram 9

☐ Yes
☐ No
☐ Partially
☐ Don't know

13.3 The chemical products I use are:

☐ Bought from a grocery store
☐ Bought from spaza shop
☐ Bought from an informal vendor (street sellers)
☐ Given to me in an unmarked container from my employer
☐ Given to me in a container with a label from my employer
☐ Other

13.4 Before using a chemical or pesticide, where do you look for on instructions on how to use the product?

☐ Newspaper articles on chemicals
☐ Google on the Internet
☐ Ask shopkeepers where you bought the product on how to use a chemical product
☐ Read information on the chemical container
☐ Use the pictures on chemical labels and follow the instructions given
☐ Do not use any written instructions
☐ I use instructions that are verbal from an external person
☐ I don’t know
☐ Other

13.5 Do you feel the label gives you enough information on the health effects and dangers of chemical products?

	Yes
	No

13.6 What other ways would you like to receive information about the dangers of chemicals and pesticides for you and your family?

13.7 What can the companies who make chemical products do to make the information on their product easily understandable to you and your community? (Except on a label)

14. Education

14.1 Which words would you like to give as examples to be put on chemical or pesticide labels?

14. 2 I will give you precautionary phrases that already are being used on chemicals or pesticides and would like you to describe in your own words what type of pictures would best describe each phrase.

Phrase 1:
P263: Avoid contact during pregnancy/while nursing.

Phrase 2:
P262: Do not get in eyes, on skin, or on clothing.

Phrase 3

P102: Keep out of reach of children.

15. Storage practices

15.1 Where do you keep chemical products in your home?

15.2 Once the chemical products are used up, what do you do with the empty chemical container?

16. Do you have any other comments about how chemical labels can help people protect children from being exposed to the contents of chemical products?

THANK YOU FOR PARTICIPATING!

Appendix 4 Afrikaans questionnaire

Vraelys wat van aangesig tot aangesig geadministreer word, wat op CommCare HQ opgelaai sal word

Student: Tatum Louw
Student number: LWXTAT001
University Supervisor: Professor Hanna-Andrea Rother
Place of study: University of Cape Town: Health Science faculty

---

Omkring die beantwoording van die antwoorde hieronder wat die MEESTE toepaslik is.

AFDELING A DEMOGRAFIESE INLIGTING

1.Wat is jou ouderdom?

- [ ] 18 – 23
- [ ] 24 – 29
- [ ] 30-35
- [ ] 36 – 41
- [ ] 42 – 47
- [ ] 48 – 54
- [ ] 55 – 60
- [ ] 61 +

2. Geslag:

- [ ] Manlik
- [ ] Vroulik
- [ ] Ander

3. 1Wat is u huistaal?

- [ ] Engels
- [ ] Afrikaans
- [ ] Isi-Xhosa
- [ ] Zoeloe
- [ ] Ander

3.2 In watter taal lees jy in?

- [ ] Engels
- [ ] Afrikaans
- [ ] Isi-Xhosa
- [ ] Zoeloe
- [ ] Ander

4. Wat gebied woon u in:

- [ ] Paarl
- [ ] Khayelitsha
- [ ] Gugulethu
- [ ] Langa
- [ ] Nyanga
- [ ] Universiteit van Kaapstad omliggende gebiede
- [ ] Noordelike voorstede
- [ ] Buite Kaapstad

5. Die tipe deelnemer waarin u in bly:

- [ ] In 'n informele nedersetting / dorp
- [ ] Op 'n plaas
- [ ] In 'n voorstad

6. Is u tans:

- [ ] Voltyds in diens
- [ ] Werkloos
- [ ] Student
- [ ] Deeltyds in diens
- [ ] Seisoenlik werksaam

7. Wat is u se hoogste kwalifikasie verwerf:

- [ ] Slaag graad 5-7
- [ ] Slaag graad 8-9
- [ ] Slaag graad 10-11
- [ ] Matrieksertifikaat
- [ ] Sertifikaat
- [ ] Baccalaureusgraad
- [ ] Honneursgraad OF Nagraadse diploma
- [ ] Meestersgraad
- [ ] Doktorsgraad
- [ ] Na-doktorsgraad

AFDELING B BEWUSTHEID VAN CHEMIES EN ETIKETTE

8.1 Beskryf in u se eie woorde wat u dink 'n 'etiket' op 'n produk gevind is:

8.2 Gee 'n voorbeeld van die etiket wat u onlangs gesien of gelees het:

8.3.1 Noem die verskillende chemiese produkte wat u vir skoonmaakdoeleindes gebruik (toon puntkaart drie vir verwysing):

- [ ] Waspoeier

	Ontsmettingsmiddel bleikmiddel
	Whitening bleikmiddel
	Dreineerder
	Paraffien
	Toiletreiniger
	Lugverfrissers

8.3.2 Noem die verskillende chemiese produkte wat u vir die doodmaak van plae in u huishouding gebruik?

	Ongemerkte straat plaagdoderproduk
	Straatplaagdoder met etiket op
	Kommersiële produk (knaagdierdoder)
	Kommersiële produk (insekdoder

8.4 Hoe weet u wanneer 'n chemikalie of plaagdoder gevaarlik is vir die gesondheid van kinders?

AFDELING C VERBETERING VAN PICTOGRAMME

9. Ek sal vir jou 'n paar prente wys wat piktogramme genoem word, wat op die chemiese etiket of plaagdoders kan verskyn. Ek sal dan vrae daaroor vra.

9.1 As u na die 6 piktogramme kyk, watter een dink u beskryf, "Hou buite die bereik van kinders" die beste:

	1
	2
	3
	4
	5
	6

9.2 Verduidelik asseblief u se antwoord vir vraag 8.1 en waarom die piktogram wat u gekies het, die beste is?

10. Ek gaan 'n paar vrae vra oor piktogramme. U kan sê of u saamstem of nie.

	Ek stem saam	Nie seker nie	Ek stem nie saam nie
10.1 Die kleur van die piktogram lok my na die chemiese etiket.	[1]	[2]	[3]
10.2 Die grootte van die piktogram vestig my aandag op die chemiese etiket	[1]	[2]	[3]

11. Ek sal vir jou 'n paar prente wys wat piktogramme genoem word, wat alreeds op die etiket van chemikalieë of plaagdoders voorkom. Ek sal dan vrae daaroor vra. .

11.1. Watter piktogramme wat u al voorheen op 'n chemiese etiket gesien het (bv. Jik, toiletreiniger, waspoeier, paraffien). U kan meer as een opsie kies.

	1
	2
	3
	4
	5
	6
	7
	8
	9

11.2 Wat beteken elke piktogram vir u (van 1 tot 9)?

12.1 As u 'n chemiese produk as gevaarlik kan bestempel, watter piktogram sou u gebruik om gevaar te toon?

12.2 Wat dink jy is 'n goeie piktogram wat aan u kan toon dat 'n chemiese produk skadelik vir u gesondheid is?

12.3 Wat dink jy is 'n goeie piktogram om aan te toon dat 'n chemiese produk skadelik is vir die gesondheid van kinders?

AFDELING D HINDERS MET BETREKKING TOT BEREIKBAARHEID:

13. Toegang tot chemiese etikette en etiketinligting

13.1. Het die chemiese produkte wat u gebruik, etikette daarop aangebring? (toon puntkaart vir deelnemers om die produkte wat hulle gebruik te sien)

	Ja, almal het etikette.
	Nie almal het nie etikette nie.
	Sommige het etikette.
	Nie seker nie

13.2 As u na die puntekaart met die nege piktogramme en hul definisies kyk, voel u dat die woord wat die piktogramme beskryf, u begrip daarvan verhoog?

13.2.1 Piktogram 1

	Ja
	Nee
	Gedeeltelik
	Weet nie

13.2.2 Piktogram 2

	Ja
	Nee
	Gedeeltelik
	Weet nie

13.2.3 Piktogram 3

	Ja
	Nee
	Gedeeltelik
	Weet nie

13.2.4 Piktogram 4

	Ja
	Nee
	Gedeeltelik
	Weet nie

13.2.5 Piktogram 5

	Ja
	Nee
	Gedeeltelik
	Weet nie

13.2.6 Piktogram 6

	Ja
	Nee
	Gedeeltelik
	Weet nie

13.2.7 Piktogram 7

	Ja
	Nee
	Gedeeltelik
	Weet nie

13.2.8 Piktogram 8

	Ja
	Nee
	Gedeeltelik
	Weet nie

13.2.9 Piktogram 9

	Ja
	Nee

☐ Gedeeltelik
☐ Weet nie

13.3 Die chemiese produkte wat ek gebruik is:
☐ Gekoop by 'n kruidenierswinkel
☐ Gekoop by spaza-winkel
☐ Gekoop by 'n informele verkoper
☐ In 'n ongemerkte houer van my werknemer aan my gegee
☐ In 'n houer met 'n etiket van my werknemer aan my gegee
☐ Ander

13.4 Voordat u 'n chemiese of plaagdoder gebruik, waar, soek u inligting oor die gebruik van die produkte?

☐ Koerantartikels oor chemikalieë
☐ Google op die internet
☐ Vra winkeliers waar u die produk gekoop het hoe om 'n chemiese produk te gebruik
☐ Lees inligting oor die chemiese houer
☐ Ek gebruik die prente op chemiese etikette en volg die aanwysings
☐ Ek gebruik geen skriftelike instruksies nie
☐ Ek gebruik instruksies wat mondeling is van 'n eksterne persoon
☐ Ander _____
☐ Ek doen dit nie

13.5 Dink u dat die etiket genoeg inligting gee oor die gevolge en gevare van chemiese produkte?
☐ Ja
☐ Nee

13.6 Op watter ander maniere wil u inligting oor die gevare van chemikalieë en plaagdoders vir u en u gesin ontvang?

13.7 Wat kan die ondernemings wat chemiese produkte vervaardig, doen om die inligting oor hul produk vir u en u gemeenskap maklik verstaanbaar te maak? (Behalwe op 'n etiket)

14. Onderwys

14.1 Watter woorde wil u gee as voorbeelde om op etikette of chemiese plaagdoders te plaas?

15. Ek sal vir u voorsorgfrases gee wat reeds op chemikalieë of plaagdoders gebruik word, en ek wil hê dat u in u eie woorde moet beskryf watter soort prentjies elke frase die beste sal beskryf.

15.1 Frase 1:
P263: Vermy kontak tydens swangerskap / tydens verpleging.

15.2 Frase 2:
P262: Moet nie in die oë, op die vel of op klere kom nie.

15.3 Frase 3

P102: Hou buite bereik van kinders.

16. Bergingspraktyke

16.1 Waar hou u plaagdoders en chemiese produkte in u huis?

16.2 Wat doen u met die leë chemiese houer sodra die chemiese produkte opgebruik is?

17. Het u enige ander opmerkings oor hoe chemiese etikette mense kan help om kinders te beskerm teen die inhoud van chemiese produkte?

DANKIE VIR U DEELNAME

Appendix 5 Pesticide information label pictogram and colour code sheet in English

Pesticide Label Pictograms and Colour Codes

Meanings of Advice & Warning Pictograms

Wear Gloves

Keep locked away and out of reach of children

Wash after use

Wear protection over nose and mouth

Wear boots

Dangerous/harmful to wildlife and birds

Not for aerial application

Wear respirator

Dangerous/harmful to fish - do not contaminate lakes, rivers, ponds or streams

Dangerous/harmful to livestock and poultry

Wear eye protection

Expiry date

Meanings of Activity Pictograms:

Handling liquid concentrate

Handling dry concentrate

Application

Meanings of Colour Codes: listed from the most (1) to the least (4) dangerous.

1 **Very Toxic**: Extremely/ Highly hazardous. Protective equipment and clothing MUST be used.

2 **Harmful**: Moderately hazardous. All safety measures stated on label MUST be used.

3 **Caution**: Slightly hazardous. Use carefully and use protective equipment.

4 **Keep Locked Away**: All pesticides are poisonous. Store away from children, food and animals.

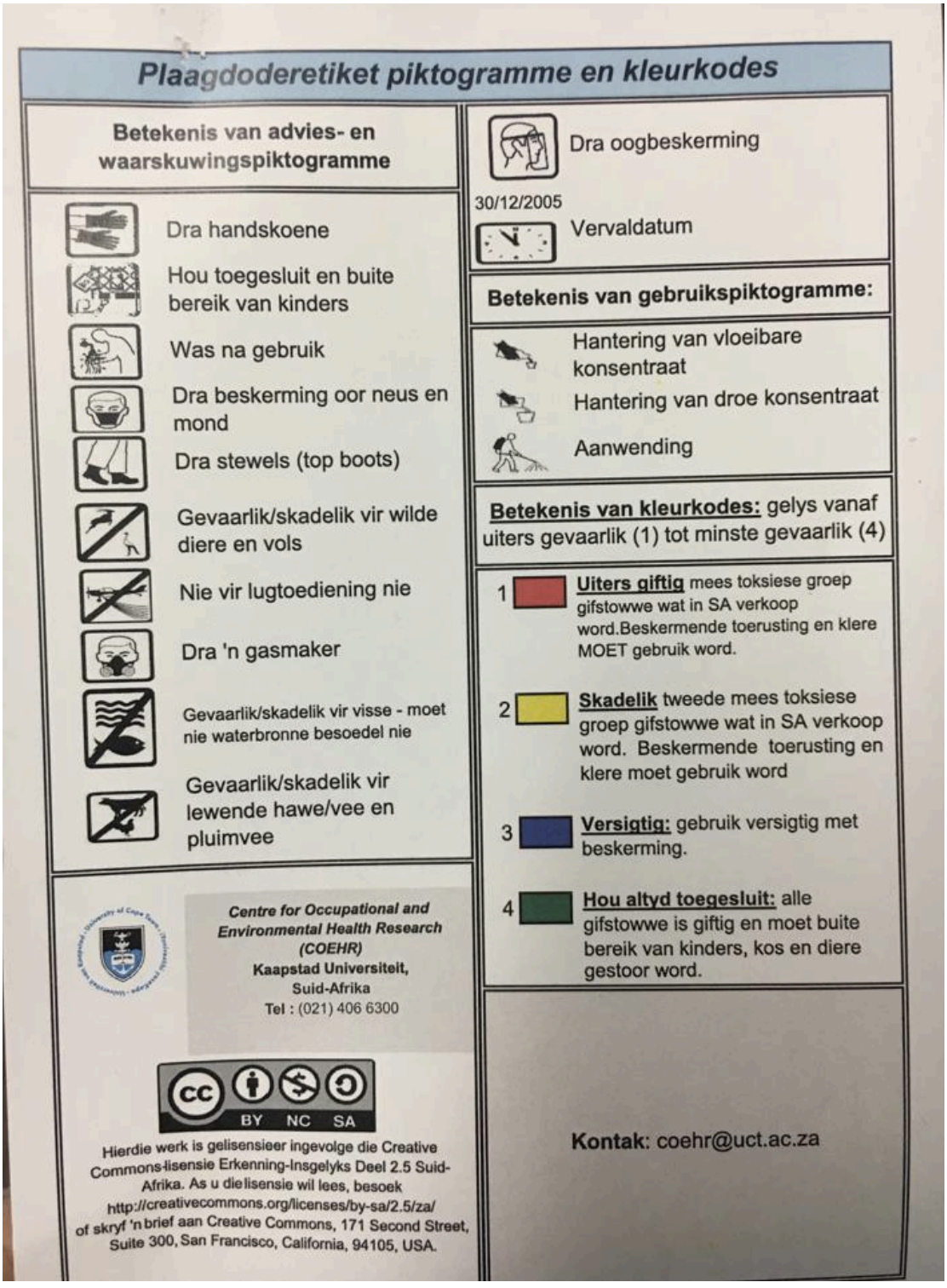
Environmental Health Division, School of Public Health and Family Medicine, University of Cape Town
Tel: +27 (0) 21 404 7661

Contact: *environmentalhealth@uct.ac.za*

CC BY NC SA

This work is licenced under the Creative Commons Attribution-Non-Commercial-Share Alike 2.5 South Africa License. To view a copy of this licence, visit http://creativecommons.org/licenses/by-nc-sa/2.5/za/ or send a letter to Creative Commons, 171 Second Street, Suite 300, San Francisco, California 94105, USA.

Appendix 6 Pesticide information label pictogram and colour code sheet in Afrikaans



Plaagdoderetiket piktogramme en kleurkodes

Betekenis van advies- en waarskuwingspiktogramme

- Dra handskoene
- Hou toegesluit en buite bereik van kinders
- Was na gebruik
- Dra beskerming oor neus en mond
- Dra stewels (top boots)
- Gevaarlik/skadelik vir wilde diere en vols
- Nie vir lugtoediening nie
- Dra 'n gasmaker
- Gevaarlik/skadelik vir visse - moet nie waterbronne besoedel nie
- Gevaarlik/skadelik vir lewende hawe/vee en pluimvee

Centre for Occupational and Environmental Health Research (COEHR)
Kaapstad Universiteit,
Suid-Afrika
Tel : (021) 406 6300

Hierdie werk is gelisensieer ingevolge die Creative Commons-lisensie Erkenning-Insgelyks Deel 2.5 Suid-Afrika. As u die lisensie wil lees, besoek http://creativecommons.org/licenses/by-sa/2.5/za/ of skryf 'n brief aan Creative Commons, 171 Second Street, Suite 300, San Francisco, California, 94105, USA.

- Dra oogbeskerming
- 30/12/2005 Vervaldatum

Betekenis van gebruikspiktogramme:

- Hantering van vloeibare konsentraat
- Hantering van droe konsentraat
- Aanwending

Betekenis van kleurkodes: gelys vanaf uiters gevaarlik (1) tot minste gevaarlik (4)

1. **Uiters giftig** mees toksiese groep gifstowwe wat in SA verkoop word.Beskermende toerusting en klere MOET gebruik word.
2. **Skadelik** tweede mees toksiese groep gifstowwe wat in SA verkoop word. Beskermende toerusting en klere moet gebruik word
3. **Versigtig:** gebruik versigtig met beskerming.
4. **Hou altyd toegesluit:** alle gifstowwe is giftig en moet buite bereik van kinders, kos en diere gestoor word.

Kontak: coehr@uct.ac.za

Appendix 7 Point chart with existing chemicals and pesticide products

COMMERCIAL PRODUCTS

14

15

16

17

18

19

20

21

22

23

24

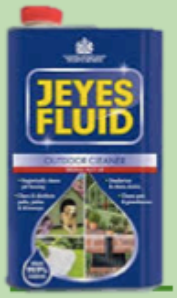
25

26

27

28

29



30

31

32

33

Produced by:

Division of Environmental Health
School of Public Health and Family Medicine
Isikolo Sempilo Yoluntu kunye Namayeza Osapho
Departement Openbare Gesondheid en Huisartskunde

UNIVERSITY OF CAPE TOWN

For more information please email:
environmentalhealth@uct.ac.za
2019

Appendix 8 Pictures of chemical product labels

Student: Tatum Louw
Student number: LWXTAT001
University Supervisor: Professor Hanna-Andrea Rother
Place of study: University of Cape Town: Health Science faculty

DIRECTIONS FOR USE:
For best results, spray onto cloth
from surface to be cleaned.
places, spray onto a cloth and
the inner surface of baths as it
PT INSTRUÇÕES DE UTILIZAÇÃO:
1. Agitar 2. Pulverizar 3. Limpar.
para um pano ou mantenha o
da superfície a limpar. Para
alcançar, pulverize para um
habitualmente. Não utilize o
interior de banheiras, pois
CAUTION:
FIRE, FLAME, OR PILOT LIGHT.
CONTAINER MAY BURST.
KEEP OUT OF REACH OF
WOOD AND NON-SEALED
INCONSPICUOUS AREA
PT CUIDADO:
PRÓXIMO DE CHAMAS
TEMPERATURAS
PERFURE NEM
PODE DEIXÁ-LO
DOS ANIMAIS.
NÃO SELADAS.
POUCO VISÍVEL
FIRST AID: IN CASE OF EYE CONTACT
PT PRIMEIROS SOCORROS:
INGREDIENTS: Hydrocarbon solvent, waxes, silicones, perfume and propellant.
See bottom of can for date manufactured, expiry date and
In case of an emergency call Poison Control Centre
Made with care and expertise by S.C. Johnson and Son
192 Smit St, Fairland 2195

HARMFUL
GEVAARLIK
VLAMBARE VLOEISTOF
FLAMMABLE LIQUID
3
Pick 'n Pay have developed No Name Brand products, representing great value at affordable prices. I am so confident of the quality, that we are offering a unique double-your-money-back guarantee. It's just another way of putting you first.
Raymond Ackerman
Pick 'n Pay
Customer
Careline
Toll Free
0800
11 22 88

Appendix 9 Nine Pictograms with descriptions

Student: Tatum Louw
Student number: LWXTAT001
University Supervisor: Professor Hanna-Andrea Rother
Place of study: University of Cape Town: Health Science faculty

1. Health Hazard

2.Corrosive

3. Flammable

4. Oxidizing

5. Toxic

6. Harmful

7. Explosive

8. Compressed Gas

9. Environmental Hazard

Appendix 10: Option to exit survey

If you do not consent to participate in this study OR you are not a caregiver to a child, kindly opt out of the study by choosing an option below and submitting the form. Thank you for your time!

Kindly tick an option below why you would like to submit the form immediately * *Mark only one oval.*

- ◯ I do not agree to participate in this study
- ◯ I am not a caregiver of a child

Appendix 11: Online Questionnaire

1. What is your age? * *Mark only one oval.*

- ◯ 18 – 23
- ◯ 24 – 29
- ◯ 30 - 35
- ◯ 36 – 41
- ◯ 42 – 47
- ◯ 48 – 54
- ◯ 55 – 60
- ◯ 61+

2. What is your gender? * *Mark only one oval.*

- ◯ Male
- ◯ Female
- ◯ Other: _____

3. 1 What is your home language? * *Mark only one oval.* English Afrikaans Isi-Xhosa Zulu Other:

- ◯ English
- ◯ Afrikaans
- ◯ Isi-Xhosa
- ◯ Zulu
- ◯ Other: _____

3.2 What language do you read in? (you may choose more than one option)

- English
- Afrikaans
- Isi-Xhosa
- Zulu
- Other: _____

4. Which area do you reside in: * *Mark only one oval.*

- Paarl
- Khayelitsha
- Gugulethu
- Langa
- Nyanga
- University of Cape Town surrounding areas
- Northern Suburbs
- Outside of Cape Town
- Other: _____

5. What type of dwelling do you reside in?

- In an informal settlement /township
- On a farm
- In a suburb

6. Are you currently? * *Check all that apply.*

Check all that apply.

- [ ] Full time employed
- [ ] Unemployed
- [ ] Student
- [ ] Part-time employed
- [ ] Seasonally employed

7. What is your highest qualification obtained?

Mark only one oval.

- Passed 5-7
- Passed grade 8- 9
- Passed grade 10 - 11
- Matric Certificate
- Certificate
- Bachelor’s Degree
- Honours Degree OR Postgrad diploma
- Master’s Degree
- Doctoral Degree
- Post doctoral

8.1 Describe in your own words what you think a “label” found on a product is for:

8.2 Give an example of label you have seen or read recently:

8.3.1 List the different chemical products you use for cleaning purposes (Pictures 27- 33 below are examples of the type products used and are not brand-specific).

Check all that apply.

- [ ] OPTION 27: Washing powder
- [ ] OPTION 28: Disinfecting bleach
- [ ] OPTION 29: Whitening bleach
- [ ] OPTION 30: Drain cleaner
- [ ] OPTION 31: Paraffin
- [ ] OPTION 32: Toilet cleaner
- [ ] OPTION 33: Air fresheners
- [ ] None
- [ ] Other: _____

8.3.1 List the different chemical products you use for cleaning purposes (Pictures 27- 33 below are examples of the type products used and are not brand-specific). *

Appendix 7 Point chart with existing chemicals and pesticide products

CHEMICAL AND PESTICIDE POINT CHART

STREET PESTICIDE PRODUCTS

1

2

3

4

5

6

7

8

9

10

11

12

13

- [ ] OPTIONS 1 or 2 or 3 or 7 or 8 or 11 or 12 or 13 (unmarked container/no label)
- [ ] OPTIONS 4 or 5 or 6 or 9 or 10
- [ ] OPTIONS 14 or 15 or 17 or 18 (Rodenticides)
- [ ] OPTIONS 16 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 (insecticides)

- [ ] None

Other: [ ] _____

8.3.2 List the different chemical products you use for killing pest in your household? (Pictures 1 - 13 below and 14- 26 from pictures in previous question) *
Check all that apply.

- [ ] OPTIONS 1 or 2 or 3 or 7 or 8 or 11 or 12 or 13 (unmarked container/no label)
- [ ] OPTIONS 4 or 5 or 6 or 9 or 10
- [ ] OPTIONS 14 or 15 or 17 or 18 (Rodenticides)
- [ ] OPTIONS 16 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 (insecticides)

- [ ] None

Other: [ ] _____

8.4 How do you know when a chemical or pesticide is dangerous for CHILDREN'S health?

_____
_____
_____
_____
_____

8.5 How do you know when a chemical or pesticide is dangerous for the health of ADULTS?

_____
_____
_____
_____
_____

9.1 Looking at the 5 pictograms below, which one do you think best describes, “Keep out of reach of children”.

Mark only one.

1 ☐

2 ☐

3 ☐

4 ☐

5 ☐

9.2 Please explain your answer to question 9.1 and why the pictogram you chose is the best one? *

Below are examples of chemical labels with pictograms. Questions 10. 1 -10.2 will be based on pictograms found on chemical labels, you can say whether you agree or disagree or if you are not sure.

Warning!
Flammable
Do not drink
Keep out of reach of children
Vapour is harmful
Do not decant into smaller containers
Do not refuel lit or hot appliances
Use only in safe and approved appliances
Danger
May cause breathing difficulty if inhaled
Danger
Toxic if swallowed
HARMFUL
GEVAARLIK
VLAMBARE VLOEISTOF
FLAMMABLE LIQUID
3
Pick 'n Pay have developed No Name Brand products, representing great value at affordable prices. I am so confident of the quality, that we are offering a unique double-your-money-back guarantee. It's just another way of putting you first.
Raymond Ackerman
Pick 'n Pay Customer Careline
Toll Free 0800 11 22 88
Specially packed for

Paste paste is a universal bait for rat control in all areas, including
Suitables.
Ingredient:
(anticoagulant)..... 0,375 g/kg
200 g
(20 x 10 g Sachets)
Racumin Paste - ZA - ZA5
holder:
(Pty) Ltd Reg. No. 1968/011192/07
143, ISANDO, 1600 SOUTH AFRICA TEL: (011) 921 5911
is a registered trademark of Bayer.
CAUTION

DIRECTIONS FOR USE:
INSTRUÇÕES DE UTILIZAÇÃO
CAUTION:
CUIDADO:
FIRST AID:
PRIMEIROS SOCORROS:
INGREDIENTS:

10.1 The COLOUR of the pictogram draws my attention to looking at it

Mark only one oval.

- I agree
- Not sure
- I disagree

10.2 The SIZE of the pictogram draws my attention to looking at it

Mark only one oval.

- I agree
- Not sure
- I disagree

11.1 For the following pictograms below, which ones have you seen before on a chemical label before (e.g.,, jik, toilet cleaner, washing powder, paraffin). You can choose more than one option. *Check all that apply. (In google forms, each pictogram had a check box next to it)*

9 existing GSH pictograms

1

2

3

4

5

6

7

8

9

11.2.1 In your own words, can you describe what pictogram 1 means to you?

1

11.2.2 In your own words, can you describe what pictogram 2 means to you?

2

11.2.3 In your own words, can you describe what pictogram 3 means to you?

3

11.2.4 In your own words, can you describe what pictogram 4 means to you?

4

11.2.5 In your own words, can you describe what pictogram 5 means to you?

5

11.2.6 In your own words, can you describe what pictogram 6 means to you?

6

11.2.7 In your own words, can you describe what pictogram 7 means to you?

7

11.2.8 In your own words, can you describe what pictogram 8 means to you?

8

11.2.9 In your own words, can you describe what pictogram 9 means to you?

9

11.3 Which chemical product would you not buy when considering reducing children's exposure and why?

12.1 Describe an image or pictogram in your own words that you feel best illustrates a danger associated with a chemical or pesticide product. *

12.2 Describe an image or pictogram in your own words that you feel best illustrates a chemical or pesticide product is harmful to your health. *

12.3 Describe an image or pictogram in your own words that you feel best illustrates a chemical or pesticide product is harmful to children's health.

13.1 On average, within the past six months, do most of the chemical or pesticides products you use have labels on them? *

Mark only one oval.

- Yes all have labels.
- No all does not have labels.
- Some has labels.
- Not sure

Question 13.2.1 Looking at the pictogram with the hazard statement next to it, do you feel the words describing the pictogram increases your understanding of it? *

Explosive; mass explosion hazard.

Mark only one oval.

- Yes
- No
- Partially
- Don't know

13.2.2 Looking at the pictogram with the hazard statement next to it, do you feel the words describing the pictogram increases your understanding of it?

Fatal when in contact with skin.

Mark only one oval.

- Yes
- No
- Partially
- Don't know

13.2.3 Looking at the pictogram with the hazard statement next to it, do you feel the words describing the pictogram increases your understanding of it?

May cause fire or explosion; strong oxidizer.

Mark only one oval.

- Yes
- No
- Partially
- Don't know

13.2.4 Looking at the pictogram with the hazard statement next to it, do you feel the words describing the pictogram increases your understanding of it? *

Very toxic to aquatic life with long lasting effects.

Mark only one oval.

- Yes
- No
- Partially
- Don't know

13.2.5 Looking at the pictogram with the hazard statement next to it, do you feel the words describing the pictogram increases your understanding of it?

Extremely flammable gas.

Mark only one oval.

- Yes
- No
- Partially
- Don't know

13.2.6 Looking at the pictogram with the hazard statement next to it, do you feel the words describing the pictogram increases your understanding of it? *

Contains gas under pressure; may explode if heated.

Mark only one oval.

- Yes
- No
- Partially
- Don't know

13.2.7 Looking at the pictogram with the hazard statement next to it, do you feel the words

Causes severe skin burns and eye damage.

describing the pictogram increases your understanding of it? *

Mark only one oval.

- Yes
- No
- Partially

May cause an allergic skin reaction.

Mark only one oval.

- Yes
- No
- Partially
- Don't know

13.2.8 Looking at the pictogram with the hazard statement next to it, do you feel the words describing the pictogram increases your understanding of it? *

13.2.9 Looking at the pictogram with the hazard statement next to it, do you feel the words describing the pictogram increases your understanding of it? *

May cause allergy or asthma symptoms or breathing difficulties if inhaled.

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ Partially
- ◯ Don't know

13.3 On average, I buy my household chemicals from:

Check all that apply.

- ☐ Bought from a grocery store
- ☐ Bought from spaza shop
- ☐ Bought from an informal vendor (street sellers)
- ☐ Given to me in an unmarked container from my employer
- ☐ Given to me in a container with a label from my employer
- ☐ Other

13.3 On average, I buy my pesticide products from:

Check all that apply.

- ☐ Bought from a grocery store
- ☐ Bought from spaza shop
- ☐ Bought from an informal vendor (street sellers)
- ☐ Given to me in an unmarked container from my employer
- ☐ Given to me in a container with a label from my employer
- ☐ Other

13.4 Before using a chemical or pesticide, where do you look for instructions on how to use the product?

Mark only one oval.

- ◯ I do not use any written instructions
- ◯ Google on the Internet
- ◯ Ask shopkeepers where you bought the product on how to use a chemical product
- ◯ Read information on the chemical container
- ◯ Use the pictures on chemical labels and follow the instructions given
- ◯ Newspaper articles on chemicals
- ◯ I use instructions that are verbal from an external person
- ◯ I don't know
- ◯ Other

13.5 Do you feel that on average that most of the chemical or pesticide products you use provide enough information of the health effects and dangers thereof?

Mark only one oval.

- ◯ Yes
- ◯ No

13.6 What other ways would you like to receive information about the dangers of chemicals and pesticides for you and your family? *

13.7.1 What can the companies who make chemical products do to make the information of their product easily understandable to you? (Except on a label) *

13.7.2 What can the companies who make chemical products do to make the information of their product easily understandable to your community? (Except on a label) *

14.1 List example of words that can be placed on chemical or pesticide labels that you feel would adequately communicate health risks that are associated with the product. *

15. 1.1 The precautionary principle P263: Avoid contact during pregnancy/while nursing, already exists as on chemicals and pesticides. In your own words, describe what type of picture would best describe the phrase. *

15. 1.2 The precautionary phrase, P262: Do not get in eyes, on skin, or on clothing, already exists on chemicals and pesticides. In your own words, describe what type of picture would best describe the phrase. *

15. 1.3 The precautionary principle, P102: Keep out of reach of children, already exists as on chemicals and pesticides. In your own words, describe what type of picture would best describe the phrase. *

16.1 Where do you keep chemical products in your home? *

16.2 On average, once chemical or pesticide products are used up, what do you do with the empty container? *

17. What other comments can you provide on how chemical labels can help caregivers protect their children from being exposed to the contents of chemical products? *

Appendix 13

UNIVERSITY OF CAPE TOWN

Faculty of Health Sciences

Human Research Ethics Committee

Room G50- Old Main Building
Groote Schuur Hospital
Observatory 7925
Telephone [021] 406 6492
Email: hrec-enquiries@uct.ac.za
Website: www.health.uct.ac.za/fhs/research/humanethics/forms

10 February 2020

HREC REF:853/2019

Division of Environmental Health
Room 4.28
Falmouth Building-FHS

Dear Prof Rother

Thank you for your response letter dated 04 February 2020, addressing the issues raised by the Facu of Health Sciences Human Research Ethics Committee (HREC).

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

Approval is granted for one year until the 28 February 2021.

Please submit a progress form, using the standardised Annual Report Form if the study continu beyond the approval period. Please submit a Standard Closure form if the study is completed within t approval period.
(Forms can be found on our website: www.health.uct.ac.za/fhs/research/humanethics/forms)

The HREC acknowledge that the student: Ms Tatum Louw will also be involved in this stud

Please quote the HREC REF in all your correspondence.

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

Please note that for all studies approved by the HREC, the principal investigator **must** obtain appropri institutional approval, where necessary, before the research may occur.

Yours sincerely

Burgess

PROFESSOR M BLOCKMAN
CHAIRPERSON, FHS HUMAN RESEARCH ETHICS COMMITTEE

Federal Wide Assurance Number: FWA00001637.
Institutional Review Board (IRB) number: IRB00001938

Prof H A Rother
PROJECT TITLE: ANALYSING THE EFFECTIVENESS OF PICTOGRAMS AS A HAZARD COMMUNICATION MECHANISM TO REDUCE CHILD EXPOSURE TO CHEMICALS IN SOUTH AFRICA. (MASTER'S DEGREE - MS TATUM LOUW)

pp HREC 853/2019sa

NHREC-registration number: REC-210208-007

This serves to confirm that the University of Cape Town Human Research Ethics Committee complie to the Ethics Standards for Clinical Research with a new drug in patients, based on the Medical Research Council (MRC-SA), Food and Drug Administration (FDA-USA), International Council for Harmonisation of Technical Requirements for Pharmaceuticals for Human Use: Good Clinical Practic (ICH GCP), South African Good Clinical Practice Guidelines (DoH 2006), based on the Association of the British Pharmaceutical Industry Guidelines (ABPI), and Declaration of Helsinki (2013) guidelines The Human Research Ethics Committee granting this approval is in compliance with the ICH Harmonised Tripartite Guidelines E6: Note for Guidance on Good Clinical Practice (CPMP/ICH/135/9 and FDA Code Federal Regulation Part 50, 56 and 312.

HREC 853/2019sa

Appendix 12 Author Environmental Research Journal Guide to Authors

Introduction

A Multidisciplinary Journal of Environmental Sciences, Ecology, and Public Health

Environmental Research: A Multidisciplinary Journal of Environmental Sciences, Ecology, and Public Health publishes original reports describing studies of the toxic effects of environmental agents and conditions in humans and animals, including both experimental subjects and ecosystems. The principal aims of the journal are to increase understanding of the etiology of preventable disease and environmental impairments, and to increase understanding of the mechanisms by which environmental agents cause disease and ecological effects. Human impact on the biosphere is considerable and, thus, an additional aim of the journal is to explore the means by which the adverse effects of anthropocentric activities can be minimized through new initiatives or changes in policy, at the local, regional, national, and international scales.

The study of environmental health is inherently multidisciplinary and international. Therefore, the journal welcomes relevant articles in epidemiology, risk analysis and policy, environmental medicine, exposure assessment, geosciences and environmental chemistry, and wildlife biology and eco-toxicology, and ecology. Reports that bridge one or more of these disciplines are particularly encouraged, as are studies employing biological markers of exposure and/or effect.

The focus of the journal generally excludes papers that report results of toxicology studies or industrial exposures, unless these papers have clear relevance to environmental topics. The journal does not generally consider reports of a specific site or source (such as an assessment of releases or environmental contamination) unless these reports present novel or generalizable information. Papers reporting on studies of human subjects must provide written assurance that the research was reviewed and approved by an appropriate institutional review board (or ethics committee) for the protection of human subjects. *Environmental Research*, in common with international practice in science, requires that all authors must, in denoting measures, utilize the metric system and SI derived units (e.g.,, degrees Centigrade rather than Fahrenheit; Click here.

Contact Details for Submission
Authors should submit their article via EES, at https://ees.elsevier.com/ER. You will be guided stepwise through the creation and uploading of the various files. Use the following guidelines to prepare your article. For any further information please visit our Support Center.

Submission checklist

You can use this list to carry out a final check of your submission before you send it to the journal for review. Please check the relevant section in this Guide for Authors for more details.

Ensure that the following items are present:

One author has been designated as the corresponding author with contact details:
• E-mail address
• Full postal address

All necessary files have been uploaded:
Manuscript:
• Include keywords
• All figures (include relevant captions)
• All tables (including titles, description, footnotes)
• Ensure all figure and table citations in the text match the files provided
• Indicate clearly if color should be used for any figures in print
Graphical Abstracts / Highlights files (where applicable)
Supplemental files (where applicable)

Further considerations
• Manuscript has been 'spell checked' and 'grammar checked'
• All references mentioned in the Reference List are cited in the text, and vice versa
• Permission has been obtained for use of copyrighted material from other sources (including the Internet)

• A competing interests statement is provided, even if the authors have no competing interests to declare
• Journal policies detailed in this guide have been reviewed
• Referee suggestions and contact details provided, based on journal requirements

For further information, visit our Support Center.

Before You Begin

Article Content
We are expecting articles of the highest scientific quality. Editorials on what the Journal is expecting in manuscripts are described in: "On multiple comparisons and on the design and interpretation of epidemiological studies of many associations" Click here. Authors are also referred to the STROBE Statement Click here.

Ethics in publishing

Please see our information pages on Ethics in publishing and Ethical guidelines for journal publication.

Policy and ethics
You are requested to provide information on funding sources supporting the work described in the manuscript. For all papers dealing with research or studies on human subjects or experimental animals, evidence must be provided of review and approval by an appropriately constituted committee for human subjects or animal research.

The work described in your article must have been carried out in accordance with *The Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans* http://www.wma.net/e/policy/b3.htm; *EC Directive 86/609/EEC for animal experiments* http://europa.eu.int/scadplus/leg/en/s23000.htm; *Uniform Requirements for manuscripts submitted to Biomedical journals*http://www.nejm.org/general/text/requirements/1.htm. This must be stated at an appropriate point in the article.

If this information is not provided upon submission, the paper will be returned without review.

Declaration of interest

All authors must disclose any financial and personal relationships with other people or organizations that could inappropriately influence (bias) their work. Examples of potential conflicts of interest include employment, consultancies, stock ownership, honoraria, paid expert testimony, patent applications/registrations, and grants or other funding. Authors should complete the declaration of interest statement using this template and upload to the submission system at the Attach/Upload Files step. If there are no interests to declare, please choose: 'Declarations of interest: none' in the template. This statement will be published within the article if accepted. More information.

Submission declaration and verification

Submission of an article implies that the work described has not been published previously (except in the form of an abstract, a published lecture or academic thesis, see 'Multiple, redundant or concurrent publication' for more information), that it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright-holder. To verify originality, your article may be checked by the originality detection service Crossref Similarity Check.

Preprints
Please note that preprints can be shared anywhere at any time, in line with Elsevier's sharing policy. Sharing your preprints e.g., on a preprint server will not count as prior publication (see 'Multiple, redundant or concurrent publication' for more information).

Use of inclusive language

Inclusive language acknowledges diversity, conveys respect to all people, is sensitive to differences, and promotes equal opportunities. Articles should make no assumptions about the beliefs or commitments of any reader, should contain nothing which might imply that one individual is superior to another on the grounds of race, sex, culture or any other characteristic, and should use inclusive language throughout. Authors should ensure that writing is free from bias, for instance by using 'he or she', 'his/her' instead of 'he' or 'his', and by making use of job titles that are free of stereotyping (e.g., 'chairperson' instead of 'chairman' and 'flight attendant' instead of 'stewardess').

Suggestion for Reviewers

Authors must suggest a minimum of 5 names of potential reviewers who should have no conflict of interests with their work or that of their co-authors, including not working at their institution. For each suggested reviewer, authors must include: Full name and title, professional affiliation, and professional email address (avoiding yahoo, hotmail, gmail, etc. addresses). Please make sure that the email addresses you provide us with are valid and up-to-date. Give also at least one reason why the author is recommending her/his name as possible reviewer.

Please note that the journal may not use your suggestions. However, your help is appreciated and may speed up the selection of appropriate reviewers.

Author contributions

For transparency, we encourage authors to submit an author statement file outlining their individual contributions to the paper using the relevant CRediT roles: Conceptualization; Data curation; Formal analysis; Funding acquisition; Investigation; Methodology; Project administration; Resources; Software; Supervision; Validation; Visualization; Roles/Writing - original draft; Writing - review & editing. Authorship statements should be formatted with the names of authors first and CRediT role(s) following. More details and an example

Changes to authorship

Authors are expected to consider carefully the list and order of authors **before**submitting their manuscript and provide the definitive list of authors at the time of the original submission. Any addition, deletion or rearrangement of author names in the authorship list should be made only **before** the manuscript has been accepted and only if approved by the journal Editor. To request such a change, the Editor must receive the following from the **corresponding author**: (a) the reason for the change in author list and (b) written confirmation (e-mail, letter) from all authors that they agree with the addition, removal or rearrangement. In the case of addition or removal of authors, this includes confirmation from the author being added or removed.
Only in exceptional circumstances will the Editor consider the addition, deletion or rearrangement of authors **after** the manuscript has been accepted. While the Editor considers the request, publication of the manuscript will be suspended. If the manuscript has already been published in an online issue, any requests approved by the Editor will result in a corrigendum.

Article transfer service
This journal is part of our Article Transfer Service. This means that if the Editor feels your article is more suitable in one of our other participating journals, then you may be asked to consider transferring the article to one of those. If you agree, your article will be transferred automatically on your behalf with no need to reformat. Please note that your article will be reviewed again by the new journal. More information.

Copyright

Upon acceptance of an article, authors will be asked to complete a 'Journal Publishing Agreement' (see more information on this). An e-mail will be sent to the corresponding author confirming receipt of the manuscript together with a 'Journal Publishing Agreement' form or a link to the online version of this agreement.

Subscribers may reproduce tables of contents or prepare lists of articles including abstracts for internal circulation within their institutions. Permission of the Publisher is required for resale or distribution outside the institution and for all other derivative works, including compilations and translations. If excerpts from other copyrighted works are included, the author(s) must obtain written permission from the copyright owners and credit the source(s) in the article. Elsevier has preprinted forms for use by authors in these cases.

For gold open access articles: Upon acceptance of an article, authors will be asked to complete an 'Exclusive License Agreement' (more information). Permitted third party reuse of gold open access articles is determined by the author's choice of user license.

Author rights
As an author you (or your employer or institution) have certain rights to reuse your work. More information.

Elsevier supports responsible sharing
Find out how you can share your research published in Elsevier journals.

Role of the funding source

You are requested to identify who provided financial support for the conduct of the research and/or preparation of the article and to briefly describe the role of the sponsor(s), if any, in study design; in the collection, analysis and interpretation of data; in the writing of the report; and in the decision to submit the article for publication. If the funding source(s) had no such involvement then this should be stated.

Open access

Please visit our Open Access page from the Journal Homepage for more information.

Elsevier Researcher Academy
Researcher Academy is a free e-learning platform designed to support early and mid-career researchers throughout their research journey. The "Learn" environment at Researcher Academy offers several interactive modules, webinars, downloadable guides and resources to guide you through the process of writing for research and going through peer review. Feel free to use these free resources to improve your submission and navigate the publication process with ease.

Language (usage and editing services)
Please write your text in good English (American or British usage is accepted, but not a mixture of these). Authors who feel their English language manuscript may require editing to eliminate possible grammatical or spelling errors and to conform to correct scientific English may wish to use the English Language Editing service available from Elsevier's Author Services.

Submission of Manuscripts

Authors are requested to submit their papers electronically by using online manuscript submission available at https://ees.elsevier.com/ER. This site will guide authors stepwise through the submission process. Authors can upload their articles as Microsoft (MS) Word, WordPerfect, or LaTeX files. It is also possible to submit an article in PostScript or Adobe Acrobat PDF format, but if the article is accepted, the original source files will be needed. Zipped files containing individual files (letter to editor, manuscript, tables, figures) can also be downloaded and the online system will extract the files and allow them to be viewed and labeled. If you submit a word processing file, the system generates an Adobe Acrobat PDF version of the article for the reviewing process. Authors, reviewers, and editors send and receive all correspondence by e-mail and no paper correspondence is necessary. The manuscript will be edited according to the style of the journal, and authors must read the proofs carefully.

Online submissions require:

Cover Letter: Document (Word, WordPerfect, RTF, PDF, LaTex) containing your cover letter to the Editors. The following statement should be included in the letter to the editor: " All of the authors have read and approved the paper and it has not been published previously nor is it being considered by any other peer-reviewed journal."

Response to Reviews (Resubmissions Only): Document (Word, WordPerfect, RTF, PDF, LaTex) detailing your response to the reviewers' and editor's comments of a previously rejected manuscript that you are re-submitting.

Manuscript: Single word processing (Word, WordPerfect, RTF) or LaTex file consisting of the title page, abstract, manuscript text, and any figure/table legends.
Manuscript file should include page numbers. Please do not include line numbering as this is automatically imposed by the editorial system.

Tables: Tables should be separate from the manuscript text, and can be uploaded individually or consolidated into a single file. The file description you input below when uploading your table must include the table number or range (e.g., Table 1, Tables 2-4).

Manuscripts must be written in English. There are no submission fees or page charges. Manuscripts are accepted for review with the understanding that no substantial portion of the study has been published or is under consideration for publication elsewhere and that its submission for publication has been approved by all of the authors and by the institution where the work was carried out; further, that any person cited as a source of personal communication has approved such a citation. Written authorization may be required at the Editor's discretion. All papers reporting on studies involving human subjects must include documentation that the study was reviewed and approved, prior to its conduct, by an appropriate institutional review board for human subjects research. No exceptions will be made to this requirement. Manuscripts that do not meet the general criteria or standards for publication in *Environmental Research* will be immediately returned to the authors without detailed review.

Environmental Research does not publish proceedings or abstracts from scientific meetings. However, the journal welcomes submissions of papers from a specific meeting under the following conditions: 1) all papers must be peer-reviewed by the journal; 2) the decision of the editors for publishing papers is final; 3) proposals for publishing such papers must be submitted in advance of the meeting; 4) the proposers must undertake preliminary review and selection of papers for submission to the Journal; and 5) these papers must be submitted as a group or within a period of three months to ensure timely and coordinated publication.

Letters to the Editor

Letters to the Editor (LTEs) are only published extraordinarily and in relation with very special topics. They are passed to external review only after a previous contact with the Editor-in-Chief, who will decide rapidly on the potential interest of the LTE for the readers of the Journal.

Preparation

NEW SUBMISSIONS

Submission to this journal proceeds totally online and you will be guided stepwise through the creation and uploading of your files. The system automatically converts your files to a single PDF file, which is used in the peer-review process.
As part of the Your Paper Your Way service, you may choose to submit your manuscript as a single file to be used in the refereeing process. This can be a PDF file or a Word document, in any format or lay-out that can be used by referees to evaluate your manuscript. It should contain high enough quality figures for refereeing. If you prefer to

do so, you may still provide all or some of the source files at the initial submission. Please note that individual figure files larger than 10 MB must be uploaded separately.

References
There are no strict requirements on reference formatting at submission. References can be in any style or format as long as the style is consistent. Where applicable, author(s) name(s), journal title/book title, chapter title/article title, year of publication, volume number/book chapter and the article number or pagination must be present. Use of DOI is highly encouraged. The reference style used by the journal will be applied to the accepted article by Elsevier at the proof stage. Note that missing data will be highlighted at proof stage for the author to correct.

Formatting requirements
There are no strict formatting requirements but all manuscripts must contain the essential elements needed to convey your manuscript, for example Abstract, Keywords, Introduction, Materials and Methods, Results, Conclusions, Artwork and Tables with Captions.
If your article includes any Videos and/or other Supplementary material, this should be included in your initial submission for peer review purposes.
Divide the article into clearly defined sections.

Figures and tables embedded in text
Please ensure the figures and the tables included in the single file are placed next to the relevant text in the manuscript, rather than at the bottom or the top of the file. The corresponding caption should be placed directly below the figure or table.

Peer review

This journal operates a single blind review process. All contributions will be initially assessed by the editor for suitability for the journal. Papers deemed suitable are then typically sent to a minimum of two independent expert reviewers to assess the scientific quality of the paper. The Editor is responsible for the final decision regarding acceptance or rejection of articles. The Editor's decision is final. More information on types of peer review.

REVISED SUBMISSIONS

Use of word processing software
Regardless of the file format of the original submission, at revision you must provide us with an editable file of the entire article. Keep the layout of the text as simple as possible. Most formatting codes will be removed and replaced on processing the article. The electronic text should be prepared in a way very similar to that of conventional manuscripts (see also the Guide to Publishing with Elsevier). See also the section on Electronic artwork.
To avoid unnecessary errors you are strongly advised to use the 'spell-check' and 'grammar-check' functions of your word processor.

LaTeX
You are recommended to use the Elsevier article class elsarticle.cls to prepare your manuscript and BibTeX to generate your bibliography.
Our LaTeX site has detailed submission instructions, templates and other information.

Article structure

For original full-length and short communications:
Introduction should be as concise as possible, without subheadings.

Materials and methods should be sufficiently detailed to enable the experiments to be reproduced.

Results and Discussion may be combined and may be organized into subheadings.

For commentaries and articles related to environmental policy, alternate formats will be accepted but should include an Introduction describing the problem in terms that a general reader will understand. All statements of fact need to be referenced and papers that make use of newly acquired data must include a Materials and methods section as well as a Results and Discussion section.

Subdivision - numbered sections
Divide your article into clearly defined and numbered sections. Subsections should be numbered 1.1 (then 1.1.1, 1.1.2, ...), 1.2, etc. (the abstract is not included in section numbering). Use this numbering also for internal cross-referencing: do not just refer to 'the text'. Any subsection may be given a brief heading. Each heading should appear on its own separate line.

Introduction
State the objectives of the work and provide an adequate background, avoiding a detailed literature survey or a summary of the results.

Material and methods
Provide sufficient details to allow the work to be reproduced by an independent researcher. Methods that are already published should be summarized, and indicated by a reference. If quoting directly from a previously published method, use quotation marks and also cite the source. Any modifications to existing methods should also be described.

Results
Results should be clear and concise.

Discussion
This should explore the significance of the results of the work, not repeat them. A combined Results and Discussion section is often appropriate. Avoid extensive citations and discussion of published literature.

Conclusions
The main conclusions of the study may be presented in a short Conclusions section, which may stand alone or form a subsection of a Discussion or Results and Discussion section.

Appendices
If there is more than one appendix, they should be identified as A, B, etc. Formulae and equations in appendices should be given separate numbering: Eq. (A.1), Eq. (A.2), etc.; in a subsequent appendix, Eq. (B.1) and so on. Similarly for tables and figures: Table A.1; Fig. A.1, etc.

Essential title page information

• ***Title.*** Concise and informative. Titles are often used in information-retrieval systems. Avoid abbreviations and formulae where possible.
• ***Author names and affiliations.*** Please clearly indicate the given name(s) and family name(s) of each author and check that all names are accurately spelled. You can add your name between parentheses in your own script behind the English transliteration. Present the authors' affiliation addresses (where the actual work was done) below the names. Indicate all affiliations with a lower-case superscript letter immediately after the author's name and in front of the appropriate address. Provide the full postal address of each affiliation, including the country name and, if available, the e-mail address of each author.
• ***Corresponding author.*** Clearly indicate who will handle correspondence at all stages of refereeing and publication, also post-publication. This responsibility includes answering any future queries about Methodology and Materials. **Ensure that the e-mail address is given and that contact details are kept up to date by the corresponding author.**
• ***Present/permanent address.*** If an author has moved since the work described in the article was done, or was visiting at the time, a 'Present address' (or 'Permanent address') may be indicated as a footnote to that author's name. The address at which the author actually did the work must be retained as the main, affiliation address. Superscript Arabic numerals are used for such footnotes.

Please note that the Journal's online editorial system (EES) now offers automatic line numbering.

Page 1 should contain the article title, the names and affiliations of all authors, and the name, telephone and fax numbers, e-mail address, and complete mailing address of the person to whom all correspondence should be sent.

Page 2 should contain an abstract and five descriptive keywords.

Page 3 provides information on funding sources supporting the work described in the manuscript. For all papers dealing with research or studies on human subjects or experimental animals, evidence must be provided of review and approval by an appropriately constituted committee for human subjects or animal research. **If this information is not provided upon submission, the paper will be returned without review.**

For original full-length and short communications:
Introduction should be as concise as possible, without subheadings.

Materials and methods should be sufficiently detailed to enable the experiments to be reproduced or the study design to be understood fully.

Results and Discussion may be combined and may be organized into subheadings.

For commentaries and articles related to environmental policy, alternate formats will be accepted but should include an Introduction describing the problem in terms that a general reader will understand. All statements of fact need to be referenced and papers that make use of newly acquired data must include a Materials and methods section as well as a Results and Discussion section.

Highlights

Highlights are mandatory for this journal as they help increase the discoverability of your article via search engines. They consist of a short collection of bullet points that capture the novel results of your research as well as new methods that were used during the study (if any). Please have a look at the examples here: example Highlights.

Highlights should be submitted in a separate editable file in the online submission system. Please use 'Highlights' in the file name and include 3 to 5 bullet points (maximum 85 characters, including spaces, per bullet point).

Abstract

A concise and factual abstract is required. The abstract should state briefly the purpose of the research, the principal results and major conclusions. An abstract is often presented separately from the article, so it must be able to stand alone. For this reason, References should be avoided, but if essential, then cite the author(s) and year(s). Also, non-standard or uncommon abbreviations should be avoided, but if essential they must be defined at their first mention in the abstract itself.

Graphical abstract

Although a graphical abstract is optional, its use is encouraged as it draws more attention to the online article. The graphical abstract should summarize the contents of the article in a concise, pictorial form designed to capture the attention of a wide readership. Graphical abstracts should be submitted as a separate file in the online submission system. Image size: Please provide an image with a minimum of 531 × 1328 pixels (h × w) or proportionally more. The image should be readable at a size of 5 × 13 cm using a regular screen resolution of 96 dpi. Preferred file types: TIFF, EPS, PDF or MS Office files. You can view Example Graphical Abstracts on our information site. Authors can make use of Elsevier's Illustration Services to ensure the best presentation of their images and in accordance with all technical requirements.

Keywords

Immediately after the abstract, provide a maximum of 5 keywords, using American spelling and avoiding general and plural terms and multiple concepts (avoid, for example, "and", "of"). Be sparing with abbreviations: only abbreviations firmly established in the field may be eligible. These keywords will be used for indexing purposes.

Abbreviations

Define abbreviations that are not standard in this field in a footnote to be placed on the first page of the article. Such abbreviations that are unavoidable in the abstract must be defined at their first mention there, as well as in the footnote. Ensure consistency of abbreviations throughout the article.

Abbreviations should follow the usage established by *Chemical Abstracts*. Please restrict the use of acronyms, especially non-standard ones, as much as possible.

Acknowledgements

Collate acknowledgements in a separate section at the end of the article before the references and do not, therefore, include them on the title page, as a footnote to the title or otherwise. List here those individuals who provided help during the research (e.g.,,

providing language help, writing assistance or proof reading the article, etc.).

Acknowledgments should be brief and should precede the references. In agreement with the Commission on Publication Ethics, authors must submit full information on sources of funding and other support for their work that is presented in their paper.

Formatting of funding sources
List funding sources in this standard way to facilitate compliance to funder's requirements:

Funding: This work was supported by the National Institutes of Health [grant numbers xxxx, yyyy]; the Bill & Melinda Gates Foundation, Seattle, WA [grant number zzzz]; and the United States Institutes of Peace [grant number aaaa].

It is not necessary to include detailed descriptions on the program or type of grants and awards. When funding is from a block grant or other resources available to a university, college, or other research institution, submit the name of the institute or organization that provided the funding.

If no funding has been provided for the research, please include the following sentence:

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Math formulae
Please submit math equations as editable text and not as images. Present simple formulae in line with normal text where possible and use the solidus (/) instead of a horizontal line for small fractional terms, e.g.,, X/Y. In principle, variables are to be presented in italics. Powers of e are often more conveniently denoted by exp. Number consecutively any equations that have to be displayed separately from the text (if referred to explicitly in the text).

Footnotes
Footnotes should be used sparingly. Number them consecutively throughout the article. Many word processors build footnotes into the text, and this feature may be used. Should this not be the case, indicate the position of footnotes in the text and present the footnotes themselves separately at the end of the article.

Artwork

Electronic artwork
General points
• Make sure you use uniform lettering and sizing of your original artwork.
• Preferred fonts: Arial (or Helvetica), Times New Roman (or Times), Symbol, Courier.
• Number the illustrations according to their sequence in the text.
• Use a logical naming convention for your artwork files.
• Indicate per figure if it is a single, 1.5 or 2-column fitting image.
• For Word submissions only, you may still provide figures and their captions, and tables within a single file at the revision stage.
• Please note that individual figure files larger than 10 MB must be provided in separate source files.

A detailed guide on electronic artwork is available.
You are urged to visit this site; some excerpts from the detailed information are given here.
Formats
Regardless of the application used, when your electronic artwork is finalized, please 'save as' or convert the images to one of the following formats (note the resolution requirements for line drawings, halftones, and line/halftone combinations given below):
EPS (or PDF): Vector drawings. Embed the font or save the text as 'graphics'.
TIFF (or JPG): Color or grayscale photographs (halftones): always use a minimum of 300 dpi.
TIFF (or JPG): Bitmapped line drawings: use a minimum of 1000 dpi.
TIFF (or JPG): Combinations bitmapped line/half-tone (color or grayscale): a minimum of 500 dpi is required.
Please do not:
• Supply files that are optimized for screen use (e.g.,, GIF, BMP, PICT, WPG); the resolution is too low.
• Supply files that are too low in resolution.
• Submit graphics that are disproportionately large for the content.

Color artwork
Please make sure that artwork files are in an acceptable format (TIFF (or JPEG), EPS (or PDF), or MS Office files) and with the correct resolution. If, together with your accepted article, you submit usable color figures then Elsevier will ensure, at no additional charge, that these figures will appear in color online (e.g.,, ScienceDirect and other sites) regardless of whether or not these illustrations are reproduced in color in the printed version. **For color reproduction in print, you will receive information regarding the costs from Elsevier after receipt of your accepted article**. Please indicate your preference for color: in print or online only. Further information on the preparation of electronic artwork.

Figure captions
Ensure that each illustration has a caption. A caption should comprise a brief title (**not**on the figure itself) and a description of the illustration. Keep text in the illustrations themselves to a minimum but explain all symbols and abbreviations used.

Tables

Please submit tables as editable text and not as images. Tables can be placed either next to the relevant text in the article, or on separate page(s) at the end. Number tables consecutively in accordance with their appearance in the text and place any table notes below the table body. Be sparing in the use of tables and ensure that the data presented in them do not duplicate results described elsewhere in the article. Please avoid using vertical rules and shading in table cells.

References

Citation in text
Please ensure that every reference cited in the text is also present in the reference list (and vice versa). Any references cited in the abstract must be given in full. Unpublished results and personal communications are not recommended in the reference list, but may be mentioned in the text. If these references are included in the reference list they should follow the standard reference style of the journal and should include a

substitution of the publication date with either 'Unpublished results' or 'Personal communication'. Citation of a reference as 'in press' implies that the item has been accepted for publication.

Reference links
Increased discoverability of research and high quality peer review are ensured by online links to the sources cited. In order to allow us to create links to abstracting and indexing services, such as Scopus, CrossRef and PubMed, please ensure that data provided in the references are correct. Please note that incorrect surnames, journal/book titles, publication year and pagination may prevent link creation. When copying references, please be careful as they may already contain errors. Use of the DOI is highly encouraged.

A DOI is guaranteed never to change, so you can use it as a permanent link to any electronic article. An example of a citation using DOI for an article not yet in an issue is: VanDecar J.C., Russo R.M., James D.E., Ambeh W.B., Franke M. (2003). Aseismic continuation of the Lesser Antilles slab beneath northeastern Venezuela. Journal of Geophysical Research, https://doi.org/10.1029/2001JB000884. Please note the format of such citations should be in the same style as all other references in the paper.

Web references
As a minimum, the full URL should be given and the date when the reference was last accessed. Any further information, if known (DOI, author names, dates, reference to a source publication, etc.), should also be given. Web references can be listed separately (e.g.,, after the reference list) under a different heading if desired, or can be included in the reference list.

Data references
This journal encourages you to cite underlying or relevant datasets in your manuscript by citing them in your text and including a data reference in your Reference List. Data references should include the following elements: author name(s), dataset title, data repository, version (where available), year, and global persistent identifier. Add [dataset] immediately before the reference so we can properly identify it as a data reference. The [dataset] identifier will not appear in your published article.

References in a special issue
Please ensure that the words 'this issue' are added to any references in the list (and any citations in the text) to other articles in the same Special Issue.

Reference management software
Most Elsevier journals have their reference template available in many of the most popular reference management software products. These include all products that support Citation Style Language styles, such as Mendeley. Using citation plug-ins from these products, authors only need to select the appropriate journal template when preparing their article, after which citations and bibliographies will be automatically formatted in the journal's style. If no template is yet available for this journal, please follow the format of the sample references and citations as shown in this Guide. If you use reference management software, please ensure that you remove all field codes before submitting the electronic manuscript. More information on how to remove field codes from different reference management software.

Users of Mendeley Desktop can easily install the reference style for this journal by

clicking the following link:
http://open.mendeley.com/use-citation-style/environmental-research
When preparing your manuscript, you will then be able to select this style using the Mendeley plug-ins for Microsoft Word or LibreOffice.

Reference formatting
There are no strict requirements on reference formatting at submission. References can be in any style or format as long as the style is consistent. Where applicable, author(s) name(s), journal title/book title, chapter title/article title, year of publication, volume number/book chapter and the article number or pagination must be present. Use of DOI is highly encouraged. The reference style used by the journal will be applied to the accepted article by Elsevier at the proof stage. Note that missing data will be highlighted at proof stage for the author to correct. If you do wish to format the references yourself they should be arranged according to the following examples:

Reference style
References should be cited in the text by the author's name and year of publication. References should be listed alphabetically in an unnumbered list at the end of the paper in the following style:

Baecklund, M., Pedersen, N.L., Bjorkman, L., Vahter, M., 1999. Variation in blood concentrations of cadmium and lead in the elderly. Environ. Res. 80, 222-230.

Oguro, M., Imahiro, S., Saito, S., Nakashizuka, T., 2015. Mortality data for Japanese oak wilt disease and surrounding forest compositions. Mendeley Data, v1. http://dx.doi.org/10.17632/xwj98nb39r.1.

Letourneau, D.K., 1997. Plant-arthropod interactions in agroecosystems. In: Jackson, L.E.(Ed.), Ecology in Agriculture. Academic Press, San Diego, pp. 239-290.

Morgan, W.K.C., Seaton, A. (Eds.), 1995. Occupational Lung Diseases, 3rd ed. Saunders, Philadelphia, pp. 308-373.

References drawn from the worldwide web must include the date in which the material was accessed.

The names of journals should be abbreviated according to the latest available edition of *Index Medicus* or *Chemical Abstracts Service Source Index*. Only articles that have been published or are in press should be included in the references. " Manuscript in preparation," " personal communication," and " unpublished observation" should be cited as such in the text.

Journal abbreviations source
Journal names should be abbreviated according to the List of Title Word Abbreviations.

Only articles that have been published or are in press should be included in the references. "Manuscript in preparation," "personal communication," and "unpublished observation" should be cited as such in the text.

Video

Elsevier accepts video material and animation sequences to support and enhance your

scientific research. Authors who have video or animation files that they wish to submit with their article are strongly encouraged to include links to these within the body of the article. This can be done in the same way as a figure or table by referring to the video or animation content and noting in the body text where it should be placed. All submitted files should be properly labeled so that they directly relate to the video file's content. In order to ensure that your video or animation material is directly usable, please provide the file in one of our recommended file formats with a preferred maximum size of 150 MB per file, 1 GB in total. Video and animation files supplied will be published online in the electronic version of your article in Elsevier Web products, including ScienceDirect. Please supply 'stills' with your files: you can choose any frame from the video or animation or make a separate image. These will be used instead of standard icons and will personalize the link to your video data. For more detailed instructions please visit our video instruction pages. Note: since video and animation cannot be embedded in the print version of the journal, please provide text for both the electronic and the print version for the portions of the article that refer to this content.

Data visualization

Include interactive data visualizations in your publication and let your readers interact and engage more closely with your research. Follow the instructions here to find out about available data visualization options and how to include them with your article.

Supplementary material

Supplementary material such as applications, images and sound clips, can be published with your article to enhance it. Submitted supplementary items are published exactly as they are received (Excel or PowerPoint files will appear as such online). Please submit your material together with the article and supply a concise, descriptive caption for each supplementary file. If you wish to make changes to supplementary material during any stage of the process, please make sure to provide an updated file. Do not annotate any corrections on a previous version. Please switch off the 'Track Changes' option in Microsoft Office files as these will appear in the published version.

Research data

This journal encourages and enables you to share data that supports your research publication where appropriate, and enables you to interlink the data with your published articles. Research data refers to the results of observations or experimentation that validate research findings. To facilitate reproducibility and data reuse, this journal also encourages you to share your software, code, models, algorithms, protocols, methods and other useful materials related to the project.

Below are a number of ways in which you can associate data with your article or make a statement about the availability of your data when submitting your manuscript. If you are sharing data in one of these ways, you are encouraged to cite the data in your manuscript and reference list. Please refer to the "References" section for more information about data citation. For more information on depositing, sharing and using research data and other relevant research materials, visit the research data page.

Data linking
If you have made your research data available in a data repository, you can link your article directly to the dataset. Elsevier collaborates with a number of repositories to link

articles on ScienceDirect with relevant repositories, giving readers access to underlying data that gives them a better understanding of the research described.

There are different ways to link your datasets to your article. When available, you can directly link your dataset to your article by providing the relevant information in the submission system. For more information, visit the database linking page.

For supported data repositories a repository banner will automatically appear next to your published article on ScienceDirect.

In addition, you can link to relevant data or entities through identifiers within the text of your manuscript, using the following format: Database: xxxx (e.g.,, TAIR: AT1G01020; CCDC: 734053; PDB: 1XFN).

Mendeley Data
This journal supports Mendeley Data, enabling you to deposit any research data (including raw and processed data, video, code, software, algorithms, protocols, and methods) associated with your manuscript in a free-to-use, open access repository. During the submission process, after uploading your manuscript, you will have the opportunity to upload your relevant datasets directly to *Mendeley Data*. The datasets will be listed and directly accessible to readers next to your published article online.

For more information, visit the Mendeley Data for journals page.

Data in Brief
You have the option of converting any or all parts of your supplementary or additional raw data into one or multiple data articles, a new kind of article that houses and describes your data. Data articles ensure that your data is actively reviewed, curated, formatted, indexed, given a DOI and publicly available to all upon publication. You are encouraged to submit your article for *Data in Brief* as an additional item directly alongside the revised version of your manuscript. If your research article is accepted, your data article will automatically be transferred over to *Data in Brief* where it will be editorially reviewed and published in the open access data journal, *Data in Brief*. Please note an open access fee of 600 USD is payable for publication in *Data in Brief*. Full details can be found on the Data in Brief website. Please use this template to write your Data in Brief.

MethodsX
You have the option of converting relevant protocols and methods into one or multiple MethodsX articles, a new kind of article that describes the details of customized research methods. Many researchers spend a significant amount of time on developing methods to fit their specific needs or setting, but often without getting credit for this part of their work. MethodsX, an open access journal, now publishes this information in order to make it searchable, peer reviewed, citable and reproducible. Authors are encouraged to submit their MethodsX article as an additional item directly alongside the revised version of their manuscript. If your research article is accepted, your methods article will automatically be transferred over to MethodsX where it will be editorially reviewed. Please note an open access fee is payable for publication in MethodsX. Full details can be found on the MethodsX website. Please use this template to prepare your MethodsX article.

Data statement
To foster transparency, we encourage you to state the availability of your data in your submission. This may be a requirement of your funding body or institution. If your data is unavailable to access or unsuitable to post, you will have the opportunity to indicate why during the submission process, for example by stating that the research data is confidential. The statement will appear with your published article on ScienceDirect. For more information, visit the Data Statement page.

After Acceptance

Online proof correction

To ensure a fast publication process of the article, we kindly ask authors to provide us with their proof corrections within two days. Corresponding authors will receive an e-mail with a link to our online proofing system, allowing annotation and correction of proofs online. The environment is similar to MS Word: in addition to editing text, you can also comment on figures/tables and answer questions from the Copy Editor. Web-based proofing provides a faster and less error-prone process by allowing you to directly type your corrections, eliminating the potential introduction of errors.
If preferred, you can still choose to annotate and upload your edits on the PDF version. All instructions for proofing will be given in the e-mail we send to authors, including alternative methods to the online version and PDF.
We will do everything possible to get your article published quickly and accurately. Please use this proof only for checking the typesetting, editing, completeness and correctness of the text, tables and figures. Significant changes to the article as accepted for publication will only be considered at this stage with permission from the Editor. It is important to ensure that all corrections are sent back to us in one communication. Please check carefully before replying, as inclusion of any subsequent corrections cannot be guaranteed. Proofreading is solely your responsibility.

Offprints

The corresponding author will, at no cost, receive a customized Share Link providing 50 days free access to the final published version of the article on ScienceDirect. The Share Link can be used for sharing the article via any communication channel, including email and social media. For an extra charge, paper offprints can be ordered via the offprint order form which is sent once the article is accepted for publication. Both corresponding and co-authors may order offprints at any time via Elsevier's Author Services. Corresponding authors who have published their article gold open access do not receive a Share Link as their final published version of the article is available open access on ScienceDirect and can be shared through the article DOI link.

Author Inquiries

Visit the Elsevier Support Center to find the answers you need. Here you will find everything from Frequently Asked Questions to ways to get in touch.
You can also check the status of your submitted article or find out when your accepted article will be published.

Appendix 13 HREC Approval

HREC REF:853/2019

Division of Environmental Health
Room 4.28
Falmouth Building-FHS

Dear Prof Rother

Thank you for your response letter dated 04 February 2020, addressing the issues raised by the Faculty of Health Sciences Human Research Ethics Committee (HREC).

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

Approval is granted for one year until the 28 February 2021.

Please submit a progress form, using the standardised Annual Report Form if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.
(Forms can be found on our website: www.health.uct.ac.za/fhs/research/humanethics/forms)

The HREC acknowledge that the student: Ms Tatum Louw will also be involved in this study.

Please quote the HREC REF in all your correspondence.

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

Please note that for all studies approved by the HREC, the principal investigator **must** obtain appropriate institutional approval, where necessary, before the research may occur.

Yours sincerely

Signature removed

PROFESSOR M BLOCKMAN
CHAIRPERSON, FHS HUMAN RESEARCH ETHICS COMMITTEE

Federal Wide Assurance Number: FWA00001637.
Institutional Review Board (IRB) number: IRB00001938

Prof H A Rother
PROJECT TITLE: ANALYSING THE EFFECTIVENESS OF PICTOGRAMS AS A HAZARD COMMUNICATION MECHANISM TO REDUCE CHILD EXPOSURE TO CHEMICALS IN SOUTH AFRICA. (MASTER'S DEGREE - MS TATUM LOUW)

HREC 853/2019sa

NHREC-registration number: REC-210208-007

This serves to confirm that the University of Cape Town Human Research Ethics Committee complie to the Ethics Standards for Clinical Research with a new drug in patients, based on the Medical Research Council (MRC-SA), Food and Drug Administration (FDA-USA), International Council for Harmonisation of Technical Requirements for Pharmaceuticals for Human Use: Good Clinical Practic (ICH GCP), South African Good Clinical Practice Guidelines (DoH 2006), based on the Association of the British Pharmaceutical Industry Guidelines (ABPI), and Declaration of Helsinki (2013) guidelines The Human Research Ethics Committee granting this approval is in compliance with the ICH Harmonised Tripartite Guidelines E6: Note for Guidance on Good Clinical Practice (CPMP/ICH/135/9 and FDA Code Federal Regulation Part 50, 56 and 312.

HREC 853/2019sa