TRNC

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EPIDEMIOLOGICAL ASSESSMENT OF THE POISONING CASES RESULTING IN DEATH WITHIN TRNC BETWEEN THE YEARS 1991-2012

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To the Health Sciences Institute,

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ABSTRACT

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Deaths by poisoning are becoming more frequent in cases within developing countries but can be seen anywhere in the world. However they are observed more frequently in the developing countries. These poisonings could be with accidental or deliberate intentions where either one will be recorded as a forensic case. In this study, poisoning cases which has occurred within TRNC are collected and assessed in order to display the rate of fatalities for the last twenty-two years. Through this data, the aim is to increase awareness on the dangers of poisonings and the substances which lead to poisonings the most. Three main governmental departments have been scanned for poisoning fatalities; Laboratory analyses, statistical reports from State Planning Organization and death certificates from Nicosia District Govern were examined, summed up, evaluated and compared with each other. Pesticides are the most frequently detected substances with 36.3% of the total cases in the laboratory analyses where alcohol was the second to that with 29.6%. Poisonings are seen often between ages of 35 and 55. Females from Nicosia cover the 58% of the deaths with the majority of medicine poisonings where males' with 42% are pesticides. From 1991 to 2012, the reports have been examined and further studies in the future years are advised on this subject where the records are kept more centrically and updated.

Key Words: TRNC, toxicology, poisonings, assessment study, fatalities

ÖZET

ARKAN, T. 1991-2012 Yılları Arasındaki KKTC'deki Ölümle Sonuçlanan Adli Olgularda Zehirlenmelerin Epidemiyolojik Olarak Değerlendirilmesi. Yakın Doğu Üniversitesi, Sağlık Bilimleri Enstitüsü, Toksikoloji Programı, Yüksek Lisans Tezi, Lefkoşa, 2012.

Ölümle sonuçlanan zehirlenmeler dünyada her yerde görülebilir. Ancak, gelişmekte olan ülkelerde bu durumun görülme sıklığı daha fazladır. Bu zehirlenmeler ister kaza eseri ister istemli olsun, her iki durumda da adli olarak kayıt altına alınırlar. Bu çalışma, son 22 yılda KKTC'de gerçekleşmiş zehirlenme olgularının araştırılmasıyla elde edilen olgu raporlarının, ölüm oranlarının gösterilmesi için değerlendirilmesini kapsamaktadır. Elde edilen veriler ile insanları zehirlenme tehlikeleri ve zehirlenmeye en çok neden olan etkenler hakkında bilinçlendirmek, bu çalışmanın amacıdır. Devlete bağlı üç ana daireden ölümle sonuçlanan zehirlenme olguları araştırılmış; laboratuvar analizleri, Devlet Planlama Teşkilatından alınan istatistik raporları ve Lefkoşa Kaymakamlığından elde edilen ölüm raporları incelenmiş, toparlanmış, değerlendirilmiş ve birbirleriyle karşılaştırılmıştır. Laboratuvar analizlerine göre bütün olgularda en sık saptanan zehirlenme etkeni %36,3 ile pestisitlerdir ve ikinci sırada %29,6 ile alkol yer almaktadır. Zehirlenmelerin en çok 35 ile 55 yaş arasında olduğu belirlenmiştir. Ölümle sonuçlanan zehirlenme olgularında, Lefkoşa'da yerleşik olanların %58'inin kadın olduğu ve bu zehirlenmelerin çoğunluğunun tıbbi ilaçlarla gözlendiği, geri kalanların (%42) ise erkek bireyler olduğu ve çoğunun pestisit kaynaklı olduğu saptanmıştır. Sunulan bu tez çalışmasında, ülkemizde 1991 yılından 2012 yılına kadar tutulan ölüm raporları gözlemsel yöntem ile epidemiyolojik olarak taranmıştır. Elde edilen bulgulara göre, sonraki yıllarda belirli süreçlerde yapılacak ileri çalışmalara gereksinim olduğu anlaşılmıştır. Bu konuda daha merkezi ve güncel kayıtların tutulması önerilmektedir.

Anahtar Kelimeler: KKTC, toksikoloji, zehirlenmeler, değerlendirme çalışması, ölümler

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ADDITIONAL

ADDITIONAL 1: Thesis Survey for Nicosia District Govern

SYMBOLS AND ABBREVIATIONS

AGR	Ministry of Agriculture and Natural Resources
CO	Carbon monoxide
FIFRA	Federal Insecticide, Fungicide and Rodenticide Act
NDG	Nicosia District Govern
OP	Organophosphates
SPO	State Planning Organization
TRNC	Turkish Republic of Northern Cyprus
WHO	World Health Organization
USA	United States of America

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1. INTRODUCTION

"What is there that is not poison? All things are poison and nothing (is) without poison. Solely the dose determines that a thing is not a poison."

Paracelsus (1493–1541).

As once spoken by the Paracelsus, the word poison describes a vast variety of substances which may or may not be toxic in certain amounts but that their dosage determines if they will be poisonous to the person they are in contact with it. Hence making it hard to clarify the meaning of the word as every substance has a potential to become toxic (*Tichy*, 1972, pp. 6-11).

Once this word was thought to only apply to the plants and animal venom but as the industries developed and widened the use of materials, the toxicity risk in the world increased along with the production of synthetics and even if the advantages of those substances such as the effects of medications were significant, they still could not be deemed fully harmless (*Patrick*, 2005, pp. 5-7). The newly established biochemical engineering produced advanced compounds to help people in their daily lives, both for their health and in their works. Such chemicals included pharmaceutical drugs and pesticides. The hazardous side effects of toxic materials have been known for centuries where with the spread of the chemicals used in many areas, the risk of poisoning increases with not only putting human lives at danger but contaminating the environment as well.

The more common and popular a chemical is, the more likely it is to be used by the people and accumulate in the environment. Pesticides, for example are potentially very hazardous chemicals where "Pesticides can be defined as any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating pests" (*Costa*, 2008, p. 883). They are useful in agriculture and helpful to fight of the unwanted pests in order to grow profitable vegetation yet if these

chemicals are not properly regulated, these extremely hazardous pesticides could be lethal to the people exposed to it. This makes it important to conduct the necessary risk assessments on chemicals within the market in order to preserve the human life.

Similarly medications and other non-pharmaceutical chemicals which can be found in houses pose a threat to human health. As stated by Milles (1999, p. 13) the science branch toxicology includes the history of forensic medicine and pharmacology showing us that the drugs we take for improving our health could be just as deadly. It is also explained that poisoning does not only occur accidentally but also for fulfilling the intents of suicide and homicide.

Without realising it people make contact with many xenobiotics in their lives and some of these lead to poisoning where the majority of these interactions are unintentional; accidental exposures due to the lack of education on the subject or excessive abuse of substances just as pointed out by Mari A. Bjornaas (2010, p. 13) in their study of acute poisoning in Oslo. The resulting death or injuries cause both psychological and economic desolation both to the people in question and others responsible for them. In light of this, it becomes essential to educate people on how to prevent poisonings, especially in countries with uncontrolled and incorrect pesticide and alike chemical sales such as Turkish Republic of Northern Cyprus (TRNC).

There are various studies conducted on the poisoning related cases where in the article by Sümer (2011, pp. 234-40), the emergency room admissions for poisonings of various cities and countries across the world; Turkey 0.9%, Nigeria 0.52%, Spain 0.3-4%, India 0.23-3.3%, Bangladesh 4.7% and Southern Cyprus as 3%. The variation between cities could be striking where even between the cities of the same country we see differentiating numbers like in Turkey; it is observed in the capital city Ankara as 0.36%, in Istanbul as 1.16% and in Kayseri as 6.2%. The differences between locations are not the only factor. Yearly changes can develop

through seasonal or geographical factors and the effects of a certain poison will also differ from person to person due to age, sex, and personal functioning of the body.

Being a developing country also causes poisoning events to escalate where the poor regulations and care as well as relying on too many chemicals in the lack of a suitable market will lead to an increase in the possible exposure routes as well factors effecting the environment (*Thundiyil et al*., 2008, pp. 205-209). The poisoning related death rates for developing countries are given as 1.8-11.6% (*Sümer et al.*, 2011, pp. 234-40). Such data is not available on TRNC and without the knowledge of the dangers created by poisoning the public remains ill-informed and indifferent on the subject. If this information is not spread amongst the people, the hazards can neither be diminished nor avoided. Preparing and presenting a thoroughly examined data on the other hand, such as this study, would raise sentience and help contain the dangers.

This study investigates the forensic poisoning cases which have resulted in deaths between the years 1991 and 2012 within TRNC. The purpose of this study is to gather, assess and form an explanatory cohort study while filling in the missing information on this area and provide certain analysed figures through investigating reports kept by the governmental departments. The number of cases recorded in these departments, the changes observed between the departments, the main substances detected, as well as age and sex factor which have effects on these cases, the death rates due to poisoning compared to general population, and differentiation of the capital from the rest of the districts will be inspected. Also this study aims to increase awareness on the poisoning to show that it is a dangerous and a common cause of death and it should be treated carefully.

This information required is limited due to the restricted accessibility in the departments. All data gathered is open to public use and each department investigated holds different limitations within itself. The data could not be obtained

from the police headquarters since forensic files are not allowed to be shared with public. The incomplete filing due to long time intervals between analyses of the cases and the lost records of the death certificates also limit the figures needed to be used.

2. BACKGROUND

2.1. History and Geographical Conditions of TRNC

Located in the Eastern-Mediterranean Sea, Cyprus is the third largest island in this region standing at the cross roads of European, Asian and African continents. Having been occupied by many civilizations of a vast range varying from Egyptians to British, Cyprus has been found to host people from surrounding regions since Neolithic Ages. A republic for the Turkish and Greek side was founded in 1960 but after the events in the next 30 years, the republic was separated into Turkish Government which was established in 1983 as Turkish Republic of Northern Cyprus, TRNC and the Greek Government of the island which is recognized as the Republic of Cyprus (*Fehmi*, 1987, pp. 31-40; *Hakeri*, 1993, pp. 13, 40-41). The information found in this study covers that of TRNC where there is no data available from the southern side of the island.

The island has a total of 9251 sq. km surface area. 35.04% of this is the area for TRNC where the majority of the remaining area in the south is the Greek population of the island with 59.55% space. There are also British and United Nations occupied zones taking up a total of 5.41% of the total area (*Yorgancıoğlu*, 1998, pp. 3-9).

According to the 2006 account, the population of TRNC is 256,644 with a growth rate of 2.6% where Nicosia has 84,776 people, 33.03% living in both the rural and the urban areas of the capital (*State Planning Organization [SPO]*, 2008, pp. 11-12). On the 4th December 2011, a new count was done and announced by unofficial records in TRNC. This counting gives an 11.2% increase since 2006 count with reaching a population of 294,906. According to this the capital Nicosia has became 98,739 and the 33.48% of the entire population where the rest of the four

districts shared the remaining population (*KKTC'nin 2011 nüfus sayısı açıklandı*, 2011).

The main occupation is agriculture based with holding the 38.21% of the export market. This is due to the semiarid climate of the island allowing extensive areas to be available for cultivation both animal husbandry, irrigated and dry land crops. The total range for farming makes up the 56.71% of the 329,890 hectares within country (*Ministry of Agriculture and Natural Resources [AGR]*, 2011, p. 5). This percentage composes the majority of the land with agricultural activities becoming an essential part of the country hence it is directly related with the increase application of chemicals in the cultivation.

There are five main districts in the northern side of the island; Nicosia as the capital, Famagusta, Kyrenia, Guzelyurt and Iskele Districts. Further regions and villages are parts of these districts and are accounted for in the study. The capital holds 15.23% area of the country with 75.41% of that region belonging to agricultural activity. Nicosia holds the third largest cultivation area. The rest of the four districts make up the remaining 84.77% with 53.35% of it used in cultivation. The largest area in both agriculture and total is that of Famagusta's. Other than agriculture, the land types are categorised as forest, grazing and unused lands (*AGR*, 2011, pp. 10-15).

2.2. Types of Poisons

From the early years of humanity, people had realized the existence of poison. Through food resources, plant roots and animals such as the snake venom, the poison was known and feared. Earlier people regarded poison as a superstitious event tying it with demons, occult and feared its deadly results (*Tichy*, 1977, p. 6). After learning about the toxic substances found in nature and how to avoid the

poison people began harvesting it, even using it in suicides and executions like the Greek Philosopher Socrates consuming the drink prepared with the poisonous hemlock (*Paul*, 1990, p. 70). It had been seen in accidental cases, and used for suicidal or homicidal purposes where in different states toxic substances can be inhaled, ingested, injected or absorbed through skin.

Substances which are not toxic enough to cause any harm in daily life, could become dangerous with uptake of excessive doses causing acute poisoning. Likewise there are constituents both capable of poisoning a person with a small amount acutely or chronically in the long term. In poisoning cases the chemical structure of the poison, duration in the body, exposure route and other routes into the body, all influence the toxicity rate but it is the dosage of the substances that separates the neutral from the toxic effects.

> The large variety of chemical compounds that show pesticide properties means that there is a very wide range of toxicity in humans. It is believed that an oral dose of only several drops (100 mg) of terbufos, an OP compound, is fatal to most adults, whereas another pesticide (amitrole) is nontoxic in humans even when several hundred grams are ingested. Even within a particular class of pesticide the lethal dose may vary considerably (*Flanagan et al*., 1998, pp. 91-95).

In his article Moffat (1998, p. 3) classifies the most encountered poison types in accordance with their analytical schemes giving seven major classes; Gases, Volatile Substances, Drugs, Metals, Pesticides, Anions and Miscellaneous Substances. The substances detected within this study include Pesticides; Pharmaceutical Drugs; Volatile Substances like Benzene and Gases like Carbon monoxide (CO); Metal like Lithium and Miscellaneous Substances like Kerosene, Cyanide and Alcohol.

2.2.1. Pesticides

> The word (description) pesticide in most discussions is used to cover substances that control organisms (insects, fungi, plants, slugs, snails, weeds, micro-organisms, nematodes, etc.) which destroy plant life and interfere with the food chain, and which act as vectors for disease organisms to man and animals. This generic definition is frequently extended, rather unsatisfactorily and inaccurately, to cover other chemicals used on plants, such as growth regulators (*Ballantyne & Marrs*, 2004, p. 1).

Having more than one type, the pesticides are found in a variety of chemicals so that they could be usable on different types of mechanisms. As stated by Costa in her study (2008, 883-884), this variation allows the pesticide to be specific for several species. Its sub types, insecticides, rodenticides, herbicides and other classes targeting definite species have chemical structures of their own. Subclasses also exist within these types, like organophosphates (OP) and pyrethroids belonging to insecticides group and they could further deviate within their subtypes greatly through their toxicological and chemical structures.

The uncontrolled application jeopardizes the human health. It is defined as a global issue with approximately three million acute poisonings recorded annually where developing countries are at a higher risk of suffering from the pesticides' dangerous effects compared to the developed countries even if these developed states have a wider market on chemicals (*Phung et al*., 2012, 468-473). In those developed countries there are systems to keep the chemicals in check; like the United States of America (USA) uses US Environmental Protection Agency under the legislation of Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) which covers the regulations of toxicity of chemicals and pesticide applications. It provides the maximum amounts of the chemicals that can be allowed in a given area. On a more international base World Health Organization (WHO) classifications are consulted. This organization mandates the regulations while giving information on many subjects which could risk health issues including pesticides, how they should be

stored, applied and which should be prescribed or not (*World Health Organization* [*WHO*], 2010, p. 3). In developing countries however such borderlines are yet to be drawn.

> In developing countries, where there is insufficient regulation, lack of surveillance systems, less enforcement, lack of training, inadequate access to information systems, poorly maintained or non-existent personal protective equipment, and larger agriculturally-based populations, the incidences are expected to be higher (*Thundiyil et al*., 2008, 205–209).

In this study for the Acute Pesticide Poisoning, Thundiyil further examines the reasons and presents weak health care availability, resources for data gathering and interpreting and laboratory analyses as well.

One of the reasons why people depend on the pesticide application is to benefit extensively from the products in agriculture. The protective chemicals would prevent the hazardous pests to damage the goods and prolong the freshness, allowing food resources to last and avert potential starvation because of pest infestations. Costa in her study also underlines the economical aspect of the situation.

> In many parts of the world, excessive loss of food crops to insects or other pests may contribute to possible starvation, and use of pesticides seems to have a favorable cost-benefit relationship. In developed countries, pesticides allow production of abundant, inexpensive, and attractive fruits and vegetables, as well as grains. In this case, cost-benefit considerations are based on economic considerations, particularly with regard to labor costs (*Costa*, 2008, p. 884).

The less damaged goods will mean there will be more obtainable income. Hence the application of pesticide would be preferable. At this point if the applications are not controlled and they remain rogue, the environment would be put at a risk with excess chemical contamination also generating health issues for not only humans but other living organisms as well.

Examples of pesticide poisonings are also seen in different parts of the world such as “In Costa Rica between 1980 and 1986, 3330 individuals were hospitalized

for pesticide poisoning, and 429 died… Of 335 poisoning deaths in Manipal, India, in the 1990s, 70% were due to cholinesterase inhibitors" (*Costa*, 2008, p. 887).

WHO classification system separates the pesticides in five major groups depending on how hazardous they are. This helps identifying the system fast and accurately. The hazardousness levels are discriminated via their LD 50 values for the rats and are as following in Table 2.1;

Table 2.1. WHO Class LD50 levels for the rats (*WHO*, 2010, p. 5).

WHO Class LD50 for the rat (mg/kg body weight) Oral and Dermal
'Ia' Extremely hazardous < 5 < 50
'Ib' Highly hazardous 5–50 50–200
'II' Moderately hazardous 50–2000 200–2000
'III' Slightly hazardous Over 2000 Over 2000
'U' Unlikely to present acute hazard 5000 or higher

The pesticides encountered in this study are given below under their respective classes, chemical types and main uses wherever available according to WHO Classification;

Table 2.2. WHO Classifications for pesticides depending on their active ingredients. Their chemical types and main uses (*WHO*, 2010, pp. 19-46).

WHO Classification for Pesticides
Class Ia - Extremely hazardous technical grade;
• Difenacoum; Coumarin Derivative - Rodenticide
• Parathion (Folidal); Organophosphate - Insecticide
• Parathion-methyl; Organophosphate - Insecticide
Class Ib - Highly hazardous technical grade;
• Dichlorvos (DDVP); Organophosphate - Insecticide
• Methamidophos (Tamaron); Organophosphate - Insecticide
• Methomyl; Carbamate - Insecticide
• Monocrotophos; Organophosphate - Insecticide
• Zinc phosphide; Rodenticide
Class II - Moderately hazardous technical grade;
• Chlorpyrifos (Dursban); Organophosphate - Insecticide
• Cypermethrin; Pyrethroid - Insecticide
• Dimethoate; Organophosphate - Insecticide
• Endosulfan; Organochloride compound - Insecticide
• Fenthion; Organophosphate - Insecticide, Larvicide
Class III - Slightly hazardous technical grade;
• Malathion; Organophosphate - Insecticide
Class U - Technical grade, unlikely to present acute hazard in normal use;
• Tetramethrin; Pyrethroid - Other use for plant pathogens treatment

2.2.2. Drugs

There have been multiple pharmaceutical drugs detected in this study. As to explain the background information on these chemicals, their types have been listed below in Table 2. 3.

Table 2.3. Pharmaceutical drug types and the drugs of interest for this study.

Drug type	**Pharmaceutical drug detected**
Anti-depressant	Amitryptyline, Venlafaxine, Sertraline, Mirtazapine
Analgesic	Brufen, Dextropropoxyphene (opioid), Paracetamol
Benzodiazepine	Diazepam, Clonazepam
Barbiturate	Barbiturate, Phenobarbitone
Anti-epileptic	Carbamazepine
Opioid Antagonist[1]	Naloxone
H2-receptor antagonist[2]	Ranitidine
Anti-hypertensive[3]	Alpha-ethyl-dopa
Alkaloid (Bronchodilator)	Theophylline
Anti-psychotic[4]	Chlorpromazine

[1] Opioid antagonists function via binding the opioid receptor in the body in order to nullify the opioid effects where it is used in long term treatments for addicts.

[2]H2 receptor antagonists are used for ingestion treatment.

[3] Antihypertensive drugs are used for treating elevated blood pressure.

[4] Antipsychotics are used in managing psychotic conditions.

Antidepressants are widely used prescribed drugs mostly taken in situations where the person has a psychiatric condition including depression, anxiety disorders, panic attacks and other similar conditions. These drugs may have adverse results where anticholinergic effects cause cognitive function declination. Amitryptyline for once is a Tricyclic antidepressant with such effects (*Jaykaran et al*., 2010, pp. 287-291).

Analgesics are pharmaceutical drugs used for easing pain where opioid analgesics drugs are used also for anaesthesia. Analgesics from opioids such as Dextropropoxyphene are used as medications. This analgesic has weak effects being no stronger than Paracetamol and it can cause multiple adverse drug reactions leading to mortality in cases of overdose. It is common to take Paracetamol with Dextropropoxyphene as analgesic (*Gauberta et al*., 2009, pp. 247–252).

The benzodiazepines, diazepam and clonazepam are anticonvulsants with mainly sedation, amnesic and hypnotic effects. Where benzodiazepines are not as much prescribed and only some are restricted, diazepam is one of the closely regulated drugs (*King et al.*, 1998, pp. 53-4).

Carbamazepine is an antiepileptic drug as a tricyclic lipophilic compound mainly used in the treatment of seizures. It has limited therapeutic range due to its active component (*Leite et al.*, 2009, 458–463). Barbiturates are anticonvulsants as well as being sedative and hypnotic drugs. They are addictive and could lead to fatalities in high doses (Barbiturate Intoxication and Overdose, 2012).

Other detected drugs include an opioid antagonist, Naloxone; a H2-receptor antagonist; Ranitidine, an anti-hypertensive agent; Alpha-ethyl-dopa, the bronchodilator alkaloid, Theophylline and the phenothiazine antipsychotic, Chlorpromazine.

2.2.3. Gases

Under this section many gases are seen and one of the most frequently seen gas to lead to fatality is perhaps Carbon monoxide. CO is an odourless and colourless gas which can cause death through inhalation. It is commonly released into the air due to hydrocarbon combustion and catabolism of chlorophyll from algae and leaves. Most of the poisoning cases occur because of the leakage from cracked coal gas containers, during fires or explosions where CO is released in confined areas such as within mines. Tobacco, paint or varnish removers with dichlotomethane or motor engines also increase the CO levels in environment and in one's body. The deaths are frequently listed as both accidental and suicidal appearing not only in TRNC but also in USA with about 4,000 annual deaths (*Eyer*, 1999, pp. 806-807).

2.2.4. Metals

Metal content of the earth changes geographically and the metals extracted are used extensively but as the trading market expand, so does the contamination spread of the various metals across the world. These metals are used in a wide range of applications differentiating from industrial machinery to food packaging. The cycle between humans intake of metal and metal lying in the earth is a well-studied subject.

Metals are redistributed naturally in the environment by both geologic and biologic cycles. Rainwater dissolves rocks and ores and transports materials, including metals, to rivers and underground water (e.g., arsenic), depositing and stripping materials from adjacent soil and eventually transporting these substances to the ocean to be precipitated as sediment or taken up into forming rainwater to be relocated elsewhere. Biological cycles moving metals include bio-magnification by

plants and animals resulting in incorporation into food cycles. *(Flanagan et al.,* 1998, pp. 107-8; *Liu et al*., 2008, 923-3).

2.2.5. Volatile and Miscellaneous Substances

Heroin, also known as diamorphine is an opioid analgesic which was derived from morphine and used as painkillers for patients in severe pain. It has an addictive feature which puts it under strict prescription only sale. It can be abused and absorbed through inhalation or smoking causing euphoria but it has heavy and lethal side effects especially in chronic users (*Patrick*, 2005, p. 152; 2005, p. 620).

Hydrochloric acid, with the symbol HCl is a solution of hydrogen chloride within water. Its inhalation is highly hazardous to humans and it can also be absorbed through skin, ingested. The adverse effects mainly include mucous irritation, hypoxemia and bronchi-constriction. Oedema and asthma are seen although rarely (*Boyce & Simpson,* 1996, pp. 422-424).

Hydrofluoric acid, HF, is a highly corrosive and toxic acid for the human body. It has many applications in the industry some of which are within organic and inorganic compound manufacture, glass, oil refinery industries and even in houses as a rust stain remover. Also used in medicine in uranium treatment, HF can cause severe tissue necrosis and systemic poisoning as well as altering calcium, magnesium and potassium levels in blood when absorbed in high concentrations (*Burgher et al.,* 2011, pp. 108–115; *Chen et al*., 2011, pp. 1907-1923).

Kerosene is formed of hydrocarbon structure and is found in liquid state. It is a crude oil and hence highly combustible where it is used for energy related applications like in cooking and lighting. It is dangerous for humans to contact as

well as being an environmental hazard which could lead to pollutions if leaked from its containers (*Ikpeme et al.*, 2007, pp. 856-860).

As an aromatic hydrocarbon with the structure of C_6H_6, benzene is widely found within substances like gasoline, engine exhaust and other parts of the industry. The conducted studies also distinguish the metabolism of benzene on different habitats, ages and sexes or smoking and variations in genes. The metabolism dissimilarity changes the toxicity levels for each person. After inhalation or another route of exposure, benzene within body causes toxicity when it metabolises. Benzene has risky effects on the human body where it can harm tissues or even result in leukaemia. Its compounds are just as dangerous, interacting with peptide and proteins hence intruding with cellular functions. Benzene is also a hazard to environment like kerosene and is spread extensively in the earth and air (*Rappaport*, 2009, pp. 946-952; 2010, pp. 189–195).

Acute cyanide poisoning can occur if cyanogenic material containing food is consumed. Amygdalin, Prunasin, Linamarin and Dhurrin are such cyanogenic compounds found in fruits mainly in the seeds. Their toxicity increases if absorbed along foods with beta-glucosidases. Sodium nitroprusside is used in medicine for malignant hypertension and could cause a cyanide poisoning (*Eyer*, 1999, p. 814). In TRNC we see consumption of apricot seeds which lead to cyanide toxicity. There are also mine sites conducting gold purifications and it becomes a place where cyanide interaction occurs.

Alcohol represents the group of compounds combined with –OH[1] where the basic compound is methanol, also known as methyl alcohol, CH3OH. Methanol has a high toxicity and is very dangerous to consume. The compound that is used the most is perhaps ethanol, the ethyl alcohol with C_2H_6O. On the other hand, in public

[1] Hydroxyl group

ethanol is usually referred to as alcohol as it is frequently used in multiple applications such as within solvents and alcoholic beverages. This consumption is common in social gatherings since it is acceptable as a social lubricant and one thing the ethanol is associated with is drunkenness. The intoxication caused by alcohol manifests itself as feeling relaxed and dizzy, while increasing heart rate speed. In advanced cases this could lead to euphoria, loss of movement control and eventually unconsciousness or even alcohol coma (*Logan et al.*, 1998, pp. 300-301; The Basics about Alcohol, 2012).

There are various alcohol limitations both put down by society and law. Even though it is not forbidden to consume alcohol, it is frowned upon if one becomes a heavy drinker with no sense of responsibilities especially if said person is drunk driving. The society morals have us drink reasonably but it is the government issued legislations that get in the way of drunk driving. The limit of alcohol in the blood for driving changes with each country. Countries such as Hungary and Czech Republic have no tolerance for drunk driving and their limit is 0.0 mg/ml; most of the others, including Turkey, TRNC and Italy has 0.5 mg/ml as a final amount; a few of them like the United States and the United Kingdom have their limits as high as 0.8 mg/ml (Blood Alcohol Concentration (BAC) Limits Worldwide, 2012).

Alcohol directly or indirectly has a major part in the death of many people. This does not only occur in TRNC but even within the developed countries in the world. Death by alcohol is not always definite though, the bodies of the dead reveal little on this sometimes and in times of indirect alcohol effect it raises questions like; was it an alcohol induced accident? Did the driver have the accident because he had consumed alcohol? Was that amount enough to incapacitate his driving? Or in cases where diseases are accepted as the primary cause of death; was the illness triggered by the long term alcohol abuse or was it a genetically inherited disease? In all these cases the alcohol dosage detected takes an important part. The analysis conducted

right afterwards would yield a good result but it still will not be accurate due to the differentiating metabolism of the people and the interval between the alcohol consumption and the death.

A direct poisoning can occur when the chronic alcoholism results in an associated disease mostly liver related ones such as cirrhosis or in an acute poisoning where it might cause an alcohol coma. Likewise the alcohol dose of consumption is a critical issue here. The intervals between and the patterns of drinking, age, gender and metabolism of the person all affect the risks of alcohol poisoning and related diseases (*Rehm et al.*, 2011, pp. 11-19).

There are differences in causes, exposure routes and admission intents of death that are seen between the studies conducted by various countries and cities. The study conducted in Oslo between the dates April 2003 and March 2004 gives fatal and non-fatal deaths by acute poisonings. As the most common substances, their study reveals opioids, mainly heroin, ethanol, anti-depressants and benzodiazepines. Accidental deaths are far more common than suicidal intents where they stating the ambiguity in determination of intent;

> Deaths by acute poisoning are mainly suicides or consequences of substance use disorders. The majority of deaths attributed to substance use disorder are considered accidental, i.e. death was not the intended outcome. However, a post-mortem determination of the intention behind a fatal intake is uncertain. Some suicides might be classified as accidental deaths, and vice versa (*Bjornaas et al.*, 2010, p. 13).

3. MATERIALS AND METHODS

This is an explanatory cohort study aiming to provide an epidemiological assessment on all the deaths caused by poisonings and alcohol related cirrhosis between the years 1991 and 2012 in TRNC. The study was conducted on the information gathered from various resources available in the northern side of the island. The cases that are being included in the study are to cover the deaths from all and from all of the districts of the TRNC.

The resources used are the TRNC Government Laboratory, Nicosia District Govern (NDG) and the Statistical Yearbook reports deployed by the State Planning Organization; Statistics and Research Department (SPO).

The Government Laboratory provided the information needed as the main basis of this study. Year by year the numbers of cases being analysed by the laboratory were given where within each year the cases with negative results were also specified. In the positive results, the substances detected from the cases were identified along with the quantities of the cases being detected with these substances. The records between the years January 1991 and April 2012 were filed providing an up to date figures for the study.

A thesis survey had been created in order to file the information found in the Nicosia District Govern (Refer to Additional 1). This survey included location of the information, cause of death, date of death, age, sex, poisoning caused by which substance and any other information related. Exposure route of substances, whether it was caused by malpractice and whether it was acute or chronic were also presented in the survey but the data could not suffice to complete these parts of the survey. Materials were obtained from the log books for death records kept in the District Govern. The autopsy or death certificates signed by the doctors and pathologist were examined for the years between January 1991 and April 2011. Anything later than

this date was not yet officially prepared. All of the logs with poisoning, cirrhosis and unknown/unidentifiable reports were recorded into the survey. The poisonings recorded were not all specific to what they were. The samples from those cases were not fixed and they remain incomplete today.

The data gathered from all three resources was examined and evaluated. The data collected is going to be assessed on its own and will be compared to the lab data. The population distribution was used against the deaths in order to provide a death rate. The total number of deaths was compared to the data from laboratory and the Nicosia District Govern. With the assistance of graphics and tables prepared from the figures between the results from different resources were related and compared to each other.

Laboratory figures will be representing the island and Nicosia District Govern data will be focusing on the Nicosia District only. The capital city was chosen because it has the highest population in the island compared to other districts. Also the marketing of the agricultural and pharmaceutical substances is the largest with high accessibility.

The chosen types of the substances are labelled as ‘Pesticides’, ‘Medicine’, ‘Alcohol’, ‘Carbon monoxide’ and ‘Others’. These types were evaluated separately in accordance with the data and most commonly appearing pesticides and medicine were studied further. The list of illegalized pesticides organized by the government in TRNC provided a means to examine which pesticides had been banned from usage; the ones had caused death before the ban, and are still actively being used and resulting in death were also studied.

Similar data collected around the world for other countries were checked. The death rates, deaths related to poisoning, and their common classification systems were linked to that of TRNC’s. The pesticides group were inspected in relation with

these countries and on its own in depth. Pesticides under study were run with World Health Organization classification which is accepted internationally and with the regulations concerning agricultural applications.

In all cases the question of ethics and the need for approval was not needed since all of the information was obtained from government files that are open to public and there are no names given out which would have compromised the privacy confidentiality regulations.

4. RESULTS

The results are in the form of data and figures gathered from three different sources, all attached to the government departments. The values from the government laboratory were analysed, stored and summed up by the officials, chemists and technicians working in the laboratory. Likewise reports from SPO were put together under government's supervision and the death certificates which were filled by doctors and pathologists were filed by officials in Nicosia District Govern. The information was obtained from these three sources and evaluated in this study. Hospital files were not kept in the hospital but passed on to the Police Centre. A more detailed data, including these finalized hospital records resides within the Police Headquarters but this data was not open to public hence it could not be used.

4.1. Results from Government Laboratory

The information collected from the analysis of the cases yielded positive results in the government laboratory between the years of January 1991 and April 2012 where only cases admitted to the laboratory specifically were examined. These figures show that the substances were recovered from the person's during analysis but whether they died from that substance is not known; it does state that it was present in the body at the time of death.

The laboratory receives the samples from the police department and the hospital, the background is not given in most circumstances and due to this there are mostly no details on the dead person's livelihood, age, sex or location of residence. This reason causes comparisons between the years based on these parameters to be missing in this study.

The data obtained from the laboratory is shown in Table 4.1. This table represents the years versus number of cases detected with substances of interest within the body. A total of 135 cases over 307 were detected to contain substances making a 43.97%. The results vary with an increase towards later years but with no constant decrease or increase in the numbers.

Table 4.1. Number of cases examined per year and number of substances detected within all of the cases in that year.

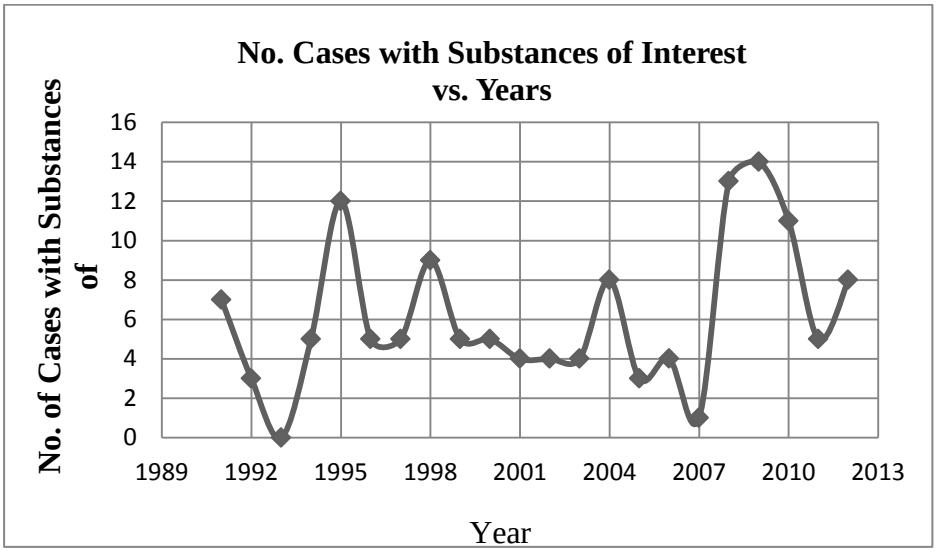
Years	**No. Cases Recorded/Year**	**No. Substances/Year**[1]
1991	7	4
1992	3	3
1993	0	0
1994	5	5
1995	12	6
1996	5	3
1997	5	4
1998	9	9
1999	5	4
2000	5	8
2001	4	3
2002	4	5
2003	4	2
2004	8	5
2005	3	2
2006	4	3

[1] No repetition of the same substances recorded within the same year.

Table 4.1. Number of cases examined per year and number of substances detected within all of the cases in that year. (Continue)

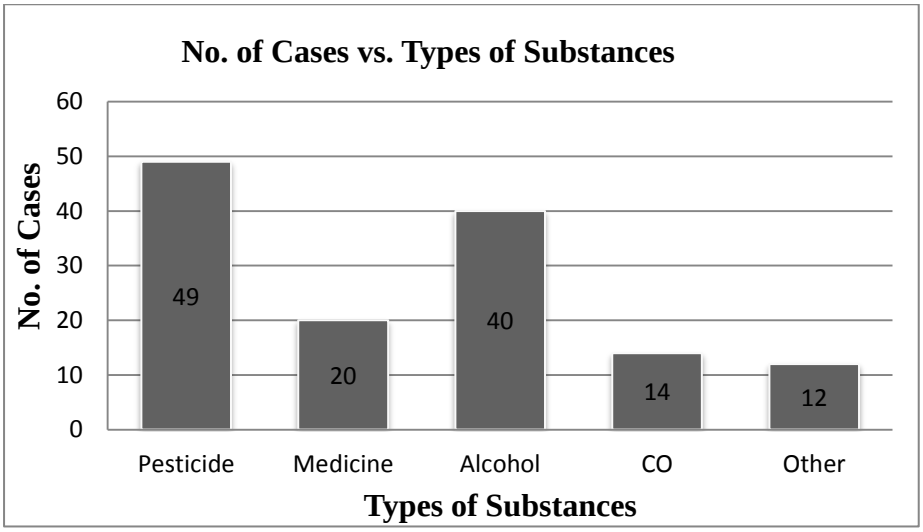
Years	No. Cases Recorded/Year	No. Substances/Year
2007	1	1
2008	13	7
2009	14	8
2010	11	6
2011	5	4
2012	8	7
Total	**135**	**99**

This variant correlation can be seen in the Graph 4.1.1 we see that there are no positive analyses on the year 1993 and there is a sharp increase from 2007 year to 2008 year.



Graph 4.1.1. Number of cases with substances of interest detected versus years.

Table 4.3 displays the substances detected in each year with giving a total of 135 numbers of cases examined. Graph 4.1.2 represents the total numbers of the cases in relation with the substances. These values show the case quantity and not the substance values where in ten events inspected, there were more than one substance detected during the examination. All of these are consistent within each other where all are either pesticides or pharmaceutical medication detected within one case.



Graph 4.1.2. Number of cases versus types of substances detected.

Pesticides are the chemicals which have been found within most cases, forty-nine cases in total (33.11%). 1991 has the highest amount and there is an increase in year 2008 after 2007. Table 4.2 gives the hazard levels for the pesticides and Table 4.3 shows how many substances were detected including multiple readings. There are fifteen different pesticides and seventeen substances used in medicine. The most common pesticide is Methomyl[1] with thirteen times (8.78%).

[1] Methomyl is a broad spectrum insecticide with restricted use.

DDVP[1] an Organophosphate insecticide is detected nine times (6.08%). DDVP is closely followed by Methyl Parathion, another Organophosphate insecticide which was detected eight times (5.41%). Other than these Dursban[2] (4.73%), Tamaron[3] (3.38%), Monochrotopos (2.03%) and Ethyl Parathion (2.03%) are identified repeatedly. Methomyl is a Carbamate, Endosulfan (0.68%) an Organochlorine and the rest of the pesticides are mostly Organophosphates including Fenthion (0.68%), Dimethoate (1.35%) and Malathion (0.68%). Others are the rodenticides Zinc Phosphate (0.68%) and Difenacoum (0.68%) with the pyrethroids, Tetramethrin (0.68%) and Cypermethrin (1.35%).

World Health Organization provides classification system for the pesticides. The identified pesticides are labelled according to this system and most are logged as highly hazardous.

Table. 4.2. Hazard levels and classes of the pesticides detected.

Hazard level	**Class**	**Pesticides identified from cases**
Extremely	**Ia**	Difenacoum, Ethyl Parathion, Methyl Parathion
Highly	**Ib**	Dichlorovos, Methamidophos, Methomyl, Monochrotopos, Zinc Phosphide
Moderately	**II**	Chlorpyrifos, Cypermethrin, Dimethoate, Endosulfan, Fenthion
Slightly	**III**	Malathion
Unlikely	**U**	Tetramethrin

[1] DDVP is also known as Dichlorovos which is a common name used in TRNC.

[2] Dursban is also known as Chlorpyrifos.

[3] Tamaron is another market name for Methamidophos used in TRNC.

In medicine column barbiturates in Table 4.3, were detected four times in total (2.70%) and Amitryptyline, an antidepressant, three times (2.03%). Paracetamol, analgesic; Theophylline, alkaloid; Diazepam, antiepileptic and Venlafaxine, antidepressant, were equally spotted for two times each (5.41%). Medicines are mainly composed of antidepressants and analgesics. These antidepressants also include Mirtazapine and Setraline where Brufen is an analgesic and Dextropropoxyphene is an analgesic opoid. The rest contain antiepileptic, Carbamazepine and Clonazepam; antipsychotic, Chlorpromazine; antihypertensive, Alphaethyldopa; opioid and H2 receptor antagonists, Naloxone and Ranitidine, respectively, all having been identified in single events as well (6.76%).

The ethyl alcohol was found in forty cases (27.03%) with different amounts, they were recorded as milligram per hundred milligrams. Most of the cases do not specify the quantities and the rest vary between 235 mg and 383 mg. These do not justify that the death was caused by alcohol; acute alcohol coma, chronic alcohol cirrhosis or alcohol poisoning. There is an increase in the cases with alcohol detection within the years of 2008 and 2010. This could be caused by an improved ethyl alcohol detection method used in the laboratory. Since the later years have decreased numbers in this chart, these detections indicate an increase in alcohol abuse and their detections accordingly within those three years.

The last panel is the combined outcomes of Carbon monoxide (9.46%) and any other potential cause resulting in death (8.11%). Carbon monoxide poisoning appears continually over the twenty years with the highest levels of 2.03% in 1995 and in 2008. Other causes include four cyanide deaths in 1995 (2.70%); three benzene related occurring in 2002, 2006 and 2012 (2.03%); one kerosene and one lamp oil[1] related in 1994 and 2009, respectively; one heroin related in 1996; one hydrochloric acid in 2001 and one Hydrofluoric acid related death in 2010 with a

[1] Both kerosene and the lamp oil are crude oil.

total of 3.38%. In 1995 the four events of cyanide poisoning are the only time where cyanide appears to have resulted in death. Bodies detected with pesticides and three Carbon monoxide deaths along with these four deaths instigated an unusually high death toll with twelve deaths when compared to the adjacent years. The only drug abuse related death is that of the heroin and as stated above the event had occurred in 1996 with no other relation to the rest of the timeline.

Table 4.3. Laboratory Results showing years, cases and the substances detected during analysis.

	Case Quantity and the Substances Detected			
Years	**Pesticides**	**Medicine**	**Ethyl Alcohol (per 100ml)[1]**	**CO/Other**
1991	2 Methyl Parathion 1 Dursban 2 Tamaron 1 Ethyl Parathion 1 Methyl Parathion, Dursban, Ethyl Parathion	-	-	-
1992	1 Monochrotophos	1 Phenobarbitone 1 Amitryptyline	-	-
1993	-	-	-	-
1994	1 Fenthion 1 Dursban	-	1 - 375mg	1 Kerosene 1 CO
1995	2 Methyl Parathion 1 Dursban 1 Monochrotophos	-	1 - 235mg	4 Cyanide 3 CO
1996	1 Methyl Parathion	-	1 - 330mg 1 - 214mg 1 - 383mg	1 Heroin
1997	1 Malathion 1 Zinc phosphate 1 Dimethoate	-	2 -	-
1998	1 Methyl Parathion, Dursban, Dimethoate 1 Endosulfan 3 DDVP 1 Methamidophos	1 Brufen 1 Carbamazepine	1 - 367mg	-

[1] The values are given where applicable

Table 4.3. Laboratory Results showing years, cases and the substances detected during analysis. (Continue.)

	Case Quantity and the Substances Detected			
Years	**Pesticides**	**Medicine**	**Ethyl Alcohol (per 100ml)**	**CO/Other**
1999	1 Dursban 1 Methomyl	-	2	1 CO
2000	1 Methyl Parathion, Dursban, DDVP 1 DDVP, Methamidophos 1 Methamidophos	1 Phenobarbitone 1 Barbiturate 1 Ranitidine, Alphaethyldopa	-	-
2001	1 Methomyl	-	-	1 HCl 1 CO
2002	-	1 Paracetamol, Dextropropoxyphene 1 Theophylline 1 Venlafaxine	-	1 Benzene
2003	1 DDVP		3	
2004	2 DDVP	1 Theophylline 1 Diazepam	3	1 CO
2005	1 Methomyl	-	1	
2006	-	-	1	1 Benzene 2 CO
2007	-	-	1	
2008	3 Methomyl 1 Tetramethrin 1 Cypermethrin 1 Ethyl Parathion	1 Amitryptyline	3	3 CO
2009	1 Methomyl 1 Dichlorovos , Monochrotophos 1 Difenacoum	1 Chlorpromazine	8	1 Lamp water 1 CO

Table 4.3. Laboratory Results showing years, cases and the substances detected during analysis. (Continue.)

	Case Quantity and the Substances Detected			
Years	**Pesticides**	**Medicine**	**Ethyl Alcohol (per 100ml)**	**CO/Other**
2010	2 Methomyl	1 Venlafaxine 1 Amitryptyline 1 Paracetamol	6	1 Hydrofloric acid
2011	1 Methomyl	1 Diazepam 1 Sertraline, Methomyl	2	-
2012	3 Methomyl 1 Cypermethrin	1 Clonazepam, Naloxone 1 Mirtazapine	1	1 Benzene
Total	49	20	40	26

4.2. Results from State Planning Organization Annual Reports

In order to relate the data from the laboratory to the general population statistics, statistical reports from SPO were checked. The summed up data evaluated from these files are the result of all of the information gathered from around the country where respective departments of the government in five districts send their figures for the main count. Then these data are checked, summarized and statistically prepared under administrative procedures. The findings are published and distributed to other departments such as local libraries for public use. These annual reports contain the population distribution by districts and death numbers where each year is examined and charted displaying deaths by selected causes and age groups. These figures are the officially registered deaths including cirrhosis, poisoning and undefined/other case reports. SPO does not separate between regions and the information on it is limited to the cases completed within the preparation time of the

report. It also has suicide as a cause of death which does not specify how the person had actually died.

From the SPO, the annual statistical reports reveal the population growth. In 1978 the population was 146,740. This number increased to 200,587 in 1996 and to 256,644 in 2006. There is a 74.90% growth between 1978 and 2006. Populations of the capital, Nicosia are 89,818 in 1996 and 84,776 in 2006 including the sub-districts which are connected to the Nicosia. The annual reports file the total number of recorded deaths in the island which is listed in Table 4.3 year by year. It also gives officially recorded causes of death and the ages of those people who died because of that cause. As with the population, the death numbers also escalate even though it is not a constant increase, the difference between 1991 and 2009 is still notable, 57.25% and the total number of deaths between 1991 and 2009 is 14660.

In Table 4.4 we see the total number of deaths and how they were catalogued by the SPO in terms of ‘Cirrhosis’, ‘Unavailable’ (NA), ‘Alcohol Coma’, ‘Suicide’ and ‘Poisoning’. Since ‘Suicide’ subtype does not state how the death has occurred, it was considered as an unknown but processed separately from the undefined cases which are mentioned under the ‘Unavailable’ sub division. The years 2010, 2011 and 2012 of the annual reports were not yet prepared and the data from those years are not known. From the Table 4.4 we can state that towards 2009 there are random differences in the figures but a general increase in the undefined cases compared to the earlier years, and a decrease in cirrhosis and poisoning ones. Alcohol coma and suicide causes show no correlation to the year advancement.

The poisoning cases are related to the age ranges indicated in the Table 4.4. ‘35-44’ range is seen seven times, having been the age range with the most poisoning cases. ‘55-64’ and ‘65-74’ have six cases each. ‘15-54’ range has five, ‘75+’ range has four and the age ranges ‘0-1’ and ‘25-34’ have three cases of poisoning each.

Poisoning events state no correlation as well. This table displays fewer cases to be recorded as it gets closer to 2009 than it recorded in the previous years.

Table 4.4. Official records from SPO listing deaths by causes and years.

		Official Records by SPO				
Years	**Deaths**	**Cirrhosis**	**NA**	**Alcohol coma**	**Suicide**	**Poisoning**
1991	641	9	16	-	-	1
1992	680	6	11	-	-	2
1993	614	6	11	-	1	2
1994	636	5	9	-	-	9
1995	778	5	-	-	5	3
1996	709	8	18	1	2	-
1997	638	6	15	1	2	5
1998	717	6	12	-	3	5
1999	717	4	15	-	1	4
2000	761	4	40	-	-	3
2001	781	1	30	-	2	1
2002	647	3	24	-	-	-
2003	683	-	32	-	1	-
2004	886	-	31	1	1	1
2005	843	-	33	-	4	1
2006	992	-	63	-	1	-
2007	969	-	44	-	-	-
2008	960	-	31	-	1	-
2009	1008	-	38	-	2	-
2010	NA	NA	NA	NA	NA	NA
2011	NA	NA	NA	NA	NA	NA
2012	NA	NA	NA	NA	NA	NA
Total	14660	63	473	3	26	37

4.3. Results from Nicosia District Govern Death Certificates

Results obtained from the District Govern of Nicosia, provide information on the files officially logged into the district govern. The data belongs specifically to the Nicosia District and its sub-districts and the date limit is between January 1991 and June 2011. The figures gathered are summed up in Table 4.5 which also displays the annual death numbers from SPO. 115 events were collected from the log books. Cases with no explanation and the ones that state being sent out for analysis are in majority with sixty-five cases, 56.52%. Deaths by cirrhosis and alcohol are put together in this table, 18.26%; nineteen of them are Chronic Alcohol cirrhosis, one of them simply states alcohol while another is noted as only cirrhosis and there are no further details on the causes of death. Two Carbon monoxide and three cyanide deaths are reported and logged in as well, taking 4.35% of the total cases.

There are four unspecified poisoning cases, another four are medicine induced and three of them are pesticide related, making up a total of 9.56%. Remaining thirteen events are identified poisoning deaths with 11.30% of the total. These have four Organophosphates, three ‘Folidol’, also known as Methyl Parathion, two Dioxin, single Lithium, Parathion and Tetanus cases. Coumadin, the anti-coagulant is also detected in one case.

Table 4.5 represents these events until the end of 2010 fully but 2011 has limited data since it only has up until the end of June. There is no data available for the year 2012 in NDG. The numbers written down with a plus sign in the year 2011 signify the potential to increase after June, in the rest of the year. The causes are split into three main groups; ‘Poisoning’, ‘Cirrhosis and Alcohol’ and ‘Unknown’. ‘Poisoning’ division include all death certificates stating any death by toxic substances whether they are pesticides, medicines or unspecified. ‘Cirrhosis and Alcohol’ section has both the chronic alcoholism and the cirrhosis as causes. ‘Unknowns’ indicate the cases which have not been identified nor have been

received back from the analysis' they had been sent out to. There are no constant correlations between these causes and the years other than an increase in unknowns although they are not continuous and there appears to be no poisoning cases between 2005 and 2009 or on the years 1994 and 1996.

Table 4.6 gives the sex and age factor in deaths by poisoning recorded in Nicosia. 58% of this total is females and 42% is males. The age range is between 5 and 80 for females where it is between 10 and 90 for males. Five of these cases are suicides and the rest are reported as accidental or unknown.

Table 4.5. Official records from Nicosia District Govern listing deaths and causes in different years.

		Officially Recorded Nicosia District Deaths		
Years	**Deaths**	**Poisoning**	**Cirrhosis/Alcohol**	**NA**
1991	641	1	-	-
1992	680	2	-	1
1993	614	1	-	2
1994	636	-	1	1
1995	778	7	1	-
1996	709	-	2	3
1997	638	2	1	-
1998	717	5	1	3
1999	717	2	-	-
2000	761	2	-	2
2001	781	2	-	9
2002	647	2	5	4
2003	683	1	-	5
2004	886	1	-	2
2005	843	-	3	4
2006	992	-	1	5
2007	969	-	-	6
2008	960	-	2	6

Table 4.5. Official records from Nicosia District Govern listing deaths and causes in different years. (Continue)

		Officially Recorded Nicosia District Deaths		
Years	**Deaths**	**Poisoning**	**Cirrhosis/Alcohol**	**NA**
2009	1008	-	-	5
2010	NA	3	1	2
2011	NA	0+	1+	5+
2012	NA	NA	NA	NA
Total	14660	31	18	60

Table 4.6. Gender and age of the fatalities due to poisoning from the death certificates of Nicosia District Govern.

Year	**No. of Cases**	**Age and Gender** [1]
1991	1	77 M
1992	2	28 F, 66 F
1993	1	39 F
1995	7	5 F, 10 M, 31 F, 33 F, 35 F, 76 F, 81 M
1997	2	65 M, 74 F
1998	5	31 F, 35 F, 36 M, 45 M, 77 M
1999	2	52 M, 80 F
2000	2	48 F, 58 F
2001	2	18 M, 79 F
2002	2	55 M, 75 F
2003	1	72 F
2004	1	16 F
2010	3	16 F, 36 M, 90 M
Total case	31; 13 M, 18 F	-
Age Range (F)	5 – 80	Mean age = 48±24.1
Age Range (M)	10 - 90	Mean age = 52±24.1

[1] F; Female. M; Male

5. DISCUSSION

In order to fully grasp today's situation on the subject of poisonings, it is required to conduct an identification study stretching from the past to our present. This study aims to cover this subject. However to be able to understand the data, the records and the departments holding these files must be kept organised. It is important to access this data easily. Newly advanced technology would make it possible for fast and safe transmittance of the data as well as storage of these records.

It is possible to access files regarding deaths related with accidental and similar type of poisoning cases through Government Laboratory, Nicosia District Govern and State Planning Organisation. Still as seen in the Table 4.1, Table 4.3, Table 4.4 and Table 4.5 along with Graph 4.1.1; there are deviations observed between the numbers within the same years of these separate resources. One reason for this differentiation is that the files could be missing or that the transfers between departments are incomplete or that the records are not stored correctly.

A headquarters where all of the poisoning submissions are kept and assessed exist in the USA as "American Association of Poison Control Centre". This centre allows data storage and availability on yearly basis hence making it possible to examine them, detect their sources for poisoning and provide solutions. Undoubtedly the establishment of online and electronic data storage under one authority in our country would be a great asset since having to gather the information on multiple departments creates confusion and misjudgement of the data.

Agricultural activities and governmental employment sector is common in TRNC. The population average is young and dynamic hence the alcohol ingestion in traffic, pesticide poisoning through agricultural works and resorting to psychiatric medications, prescribed or not, due to high levels of stress inflicted by wearisome life styles increase conscious and accidental poisonings. In regards with displaying the

significance of poisoning, it is necessary to gather and analyse the data within certain time intervals just like it is done in this study. This way the main problems can be identified henceforth governmental and educational precautions can be maintained.

This study displays the deaths caused by pesticides, medicines, alcohol, CO and other toxic substances; it shows how they are recorded and filed after laboratory analysis', within annual statistics reports and in district govern records. It provides a systemically summed up and detailed form of these deaths, being the first collected data on this subject in TRNC. Unknown figures pose a limitation in reaching the exact amounts of these cases yet the established data allow for an explanatory study to be conducted. There are also more poisoning cases filed which happen without resulting in death but they were not examined in this study. "Further, while inpatient hospital records, suicide registries, forensic evidence and personal interviews may provide the strongest support for causation, these modes are too narrow and fail to provide adequate surveillance" (*Thundiyil et al.*, 2008, pp. 205-209).

The pesticide types were checked by WHO classification and it shows the results of the impact of unregulated pesticide market on people. This examination presents the uncorrelated results of the three different resources and shows the variety within the data even though all of the parameters checked for these sources are the same.

Detection of 148 substances within 135 of the 307 analysed cases presents the importance in the high levels of deaths within the twenty-two years period this study examines. The death toll within the first nineteen years examined, up until 2009, is 14660. Within this time 111 poison related deaths over 135 of the total timeline examined represent a small yet an important portion. The variety in examination of the dates is due to the lack of information on later years. The laboratory analysis does not state whether the death was caused by these substances but it still shows that there is enough of these materials in the environment and are easily accessible which

contaminate our bodies and be detectable in post mortem examinations. When the age factor is examined where available, the variety of the ages observed indicate the dangers of contamination for all of the people whether they are directly involved of these substances or not.

Uncontrolled pesticide usage is one of the most significant factors within the 135 deaths. Laboratory results show deaths by pesticides with hazardous active ingredients. “Due to the wide range of pesticides and their toxicities, clinical presentations can vary significantly. Additionally, it can be difficult to determine whether nonspecific symptoms are actually due to the pesticide exposure or other common environmental factors such as heat illness” (*Thundiyil et al.*, 2008, pp. 205-209). Most of these pesticides are labelled as either extremely or highly hazardous by WHO classification system and are subjected to restricted use internationally. In TRNC there are no regulations to keep their applications in check hence resulting in death via contamination of dangerous chemicals. In such situations Difenacoum, the Coumarin derivative; Ethyl-Parathion and Methyl-Parathion, Organophosphates which are the ‘Ia’ class of extremely hazardous pesticides, have been reported to have caused twelve deaths.

Even more Methomyl, a highly hazardous carbamate with ‘Ib’ class is allowed to be applied with no limitations; the chemical’s unconscious usage is still causing harm to people. Since 1999 this pesticide has been killing those exposed to it almost on a yearly basis. It has been recorded 13 times on its own in the cases and once along with Sertraline, the antidepressant in 2011. Other ‘Ib’ classes including Dichlorvos, Methamidophos and Monocrotophos, all Organophosphates have appeared seventeen times across the timeline. Zinc Phosphate as a rodenticide has a singular case in 1997.

‘Ia’ and ‘Ib’ classes which caused death over the twenty-two year course are mostly Organophosphates showing the extensive application in the island. These

could be either environmental, chronic exposures or through consumption. Most of them are of accidental nature with a few suicidal intentions recorded.

Similarly Class ‘II’, Moderately Hazardous pesticides, Chlorpyrifos also known as Dursban, Dimethoate, Fention and Class ‘III’ Slightly Hazardous pesticide Malathion are all Organophosphates having been detected eleven times. There are nine different types of OP pesticides. The total number for the OP pesticide detections are 39, taking up the 79.59% of all the recorded substances detected within all cases. Class ‘II’ Endosulfan is an Organochloride where Cypermethrin is of the same class and Tetramethrin of Class ‘U’, Unlikely to present acute hazard in normal use, are seen 4 times.

Out of the fifteen different pesticides, twelve of those have their main uses as insecticides. This indicates the heavy application of this pesticide subtype. Remaining ones Difenacoum and Zinc phosphide are rodenticides where Tetramethrin is a chemical applied in plant pathogen treatment.

Generally there are no correlations between the years other than the ones already mentioned but a onetime event occurs in the year 2011 where a case with both a pesticide and a medication is detected together. Other analyses have been seen to include multiple chemicals within but they are either all pesticides or all medicines. In this single event, Sertline, the antidepressant and Methomyl, the insecticide have been recorded. Due to the lack of background information, discussion of this occurrence remains inconclusive but it is known that antidepressants are given with prescriptions where pesticide can be purchased freely. The poisoned person could be under psychiatric treatment taking an antidepressant as well as being someone involved in agriculture. Consuming this typical medication suggests that the person has a potential to commit suicide but actually detecting it within the system means that either the medication failed to take effect, perhaps due to building a resistance or that the cause of death is the overdose of Sertline and that

the pesticide is obtained from environmental exposure. Likewise if the detected amount of Sertline is not enough to cause poisoning and due to resistance of the body towards the medication, the psychologically unstable person might have uptake Methomyl, not to forget that the person could have taken both at the same time. If it is not a suicide, with similar reasons the person might have been exposed to it accidentally. The key point here is to show the importance in background information. However small or irrelevant they may appear, the details will entail the circumstances of death and clear away any doubts in how the death has occurred. Eventually this will lead to a better understanding of how people live and die on the island along with its relation not only to poison but to other parameters.

The rest of the cases would follow along similar lines each with their own unique situations, also including those that may not have resulted in death although this is unlikely. As mentioned before these are only speculations based on the data on hand and could change if the true background facts are acquired.

In 17 March 2012, the list about the banned pesticides which was arranged by the Agriculture and Natural Resources Department of TRNC was updated. This list included eight of the chemicals mentioned in this thesis; first three were Methamidophos, Ethyl Parathion and Monocrotophos. These pesticides had been recorded to have caused deaths in 2000, 2008 and 2009, respectively. Other five were Endosulfan, Fenthion, Dichlorovos, Methyl Parathion and Methomyl. These eight pesticides are banned from manufacturing, exporting, marketing or applying in TRNC. Even after the ban, the the remaining prohibited pesticides which were not collected from the users and the accumulation causes the chemicals to show up in analysis. Farmers of course would not be throwing away the purchased materials without finishing them and the government who is supposed to collect these banned chemicals would not be able to follow the leads since there are no logs for the sale of Class ‘Ia’ and ‘Ib’ pesticides.

In the last ten years we see a slight demotion in the number of pesticide poisonings. In the year 2012 this is mostly due to the incomplete work records and as for the remaining years it can be related to the fact that most analyses sent to the laboratory within the last few years have neither been finalized nor filed in the archives. Also investigations which cannot be settled in TRNC due to the lack of equipment are being directed to laboratories in Turkey where it takes a certain time for the results to come back. Because of this the files and the quantities of cases kept by the TRNC laboratory are not consistent with the number of events occurring in the island. This makes it hard to say whether the statistics created from laboratory results alone are sufficient enough to represent the poisoning cases in TRNC.

Similarly the pharmaceutical drugs detected and identified in laboratory does not correspond to the complete list of all of the medicine centred poisoning cases happened in the island. These medical supplies responsible for twenty deaths as seen in Table 4.3 are not observed as frequently as the pesticides which have brought about forty-nine officially recorded deaths with in the same twenty-two year course. Again the cause of death is unknown in these cases and it is not necessarily linked to these drugs.

In the earlier years there is a distinctive lack of medicine poisonings. This could be due to lack of organized documentation and filing or the deficiency of the equipment with which the active ingredients were meant to be detected. Even later the number does not increase as much as the alcohol induced poisonings have. The symptoms the medicines generate could be similar to that of natural causes. This makes the post mortem examination unclear, especially for the elderly, on deciding whether it was natural or that it was medication instated. Whether it was overdose or an adverse side effect of the chemical is hard to distinguish.

There are a variety of medications identified and the prescribed drugs like antidepressants were witnessed the most often with seven notable cases.

Amitryptyline is found in 1992, 2008 and 2010. Venlafaxine is seen in 2002 and 2010. Both of these two antidepressants are seen in 2010, a year with particularly high number of events. The remaining two antidepressants, Sertraline and Mirtazapine, appear in later on the timeline within 2011 and 2012 possibly showing that these were new on market in TRNC and were becoming widespread between patients; Table 4.3. In Turkey Amitryptyline is listed as the third most common drug to cause poisoning in the year 2008 according to National Poisoning Centre in Turkey; Sertraline is fourth and venlafaxine is twenty-seventh where Paracetamol heads the list in the same year (*Epidemiyloji Raporu*, 2009, p. 70).

Analgesics and benzodiazepines were also detected more frequently than the rest of the the medications, in three cases each. Paracetamol and Dextropropoxyphene are detected together in a single case in 2002. Brufen and Paracetamol cases each appear in 1998 and 2010 respectively showing us that the medication found in many households could lead to severe poisoning and it could happen in any year.

Benzodiazepine poisoning on the other hand is only seen after the year 2004. The next one is detected in 2011 and 2012. Diazepam is under regulations since it is a dangerous medication and is applied as a sedative and as an anticonvulsant. If death is not the result of drug abuse then the person could have already got the drug in the blood due to prior medical applications before death. The latter case in 2012 includes both Clonazapam and Naloxone, an opioid antagonist where both drugs are only detected once and together in this single case. A further study of the upcoming years and repeatability of their detections are needed to properly discuss the reasoning behind this case.

Barbiturates are not common in the list but it is seen that two Phenobarbitone and one barbiturate cases are present in 1992 and 2000. There are no other cases recorded after 2000 within the next decade. They are seen most likely due to

addictions and where they are used as anticonvulsants, they might not be the sole reason for death but could present in body if the person has been taken them regularly.

Again in 2000, there is a case where two drugs are detected in a single analysis. Ranitidine, the H2-receptor antagonist and Alpha-ethyl-dopa, an anti-hypertensive agent are both present. This could be due to the person under treatment having to uptake multiple drugs habitually. It is an unusual case since these drugs are only seen once and are detected together in analysis.

Theophylline can be both found as a bronchodilator and as a chemical within drinks such as tea and coffee. These two drinks are both a large part of the Turkish culture and are consumed on daily basis but there are no specific circumstances filed in TRNC, relating this to their toxicity and it is unlikely that ingestion of beverages would cause poisoning unless they have been taken in vast amounts. Hence it is more possible for Theophylline as a drug to have been detected in two events in 2002 and 2004.

The other two substances appear in separate cases. Carbamazepine is an antiepileptic drug with limited therapeutic range. Since its active ingredient is dangerous, people could easily go over the prescribed amount, accidentally or not, and the effects of the overdose will arise. Such is possible in the event in 1998. In a single case we see Chlorpromazine, where the antipsychotic drug is detected in 2009, as another prescribed drug.

Deaths induced by alcohol were also considered in this study. The reports state that the alcohol was detected in the system in post-mortem analysis. The causes of death were not given hence the death could be triggered by acute uptake of alcohol or a chronic alcoholism. There are possibilities of alcohol poisoning, acute alcohol coma and cirrhosis of the liver initiated by chronic alcoholism. Other than

poisonings, traffic accidents while drunk driving or similar cases are also included in the list since the exact backgrounds on people were not accessible. It can be seen that there is an escalation in the number of deaths with alcohol in their systems starting from 2003. The documented quantities of the years after 2003 are three times the total amount of cases observed before the this year. In Sweden, the most detected substance during examinations was ethanol between the years 1992 and 2002 even though it was competing with pharmaceutical drugs (*Jönsson et al.,* 2004, pp. 53-59).

Oxygen deficiency in air during a fire or smoke spreading from heater stoves produce carbon monoxide which is highly toxic for humans when inhaled. This toxicity can lead to fatalities in which the residues obtained from the lungs can reveal death by carbon monoxide inhalation. In TRNC, we see fourteen confirmed cases which had been linked to such deaths. An almost even distribution is seen before and after the years 2002 and 2003 where there are no correlations between the years. Yet the number is high enough to be studied separately from the other causes of death.

The remaining column labelled ‘CO/Others’ in Table 4.3 indicates causes which has appeared less than five times each during the twenty-two years. Graph 4.1.2 shows the numbers for CO and others separately. Heroin is also found in this part because it is the only drug related death analysed in the laboratory.

The Hydrochloric acid and Hydrofluoric acid poisoning events are not common in TRNC and there are one in 2001 and another in 2010, respectively. Since both of their application areas are vast, it is hard to pinpoint the exact reason behind poisoning but when compared with other cases it is highly likely that they were household products related poisonings; Table 4.3.

Benzene within gasoline is found broadly in TRNC where its environmental contamination is elevated due to its once heavy use. The amount of people with cancer in the island is high as it is and benzene is thought to have played a part in this

through its carcinogenic features linking it to lymphohematopoietic cancer form (*Rappaport et al.,* 2010, pp. 189–195). Indirectly the side effect of environmental benzene contamination could lead to a number of cancer cases although these numbers cannot be specified nor proved since there could be multiple reasons for cancer in the island. The poisoning cases could relate to chronic exposure especially with those in occupational hazard of benzene while working in gasoline stations. Three benzene related cases exist in 2002, 2006 and 2012.

Cyanide in CN- form is present in the seed of apricots where if consumed in high amounts it leads to poisonings. Cyanide purification in gold mining also creates a pathway for cyanide interactions (*CMC'nin Altın Madenleri – Lefke'nin Siyanürlü Geçmişinden…,* 2001). Due to the ingestion of these seeds or via purification process in mines poisonings by cyanide had occurred in the year 1995 which has led to fatalities. In Annual Death Reports we see three cases, a woman and two children with cyanide poisoning and the remaining case is unknown.

Nicosia District Govern stores the death certificates and unfortunately with limited information on them. The explanations and the coroner's reports only display the initial findings and the samples sent for analysis are kept confidential and are not processed in the District Govern. Discontinuity of the procedure causes the data found to be partial and without detail. In Table 4.5 the separation of the causes are seen as three parts where there are 31 poisoning, 18 cirrhosis and 60 unknown cases. It is detected that multiple pesticide and medication poisoning along with Carbon monoxide and alcohol related deaths.

Nicosia district, with its high population show variety in the numbers when compared with laboratory works which analyse the samples from all around the north side of the island. It is seen that the recorded quantities of pesticide and medication poisoning cases are 69 in laboratory where there are 31 of them which were collected from the death certificates of the capital city. If all the cases are assumed to present

in both departments, this makes the 44.93% of the cases of Nicosia origin. This value can be considered high since the rest of the four cities would have a total of 57.97% and Nicosia alone is close to the half of the total quantities. Also if the four cities are assumed to have equal amounts, Nicosia would have cases three times more than each city on its own.

Under poisonings column in Table 4.5, there is a random appearance of the quantities. 1995 gives the peak of the list with seven deaths. Like the results in laboratory most of the samples acquired in post mortem examinations are sent out for analysis which have not been received back to complete the procedure. Even if there are no filed cases in District Govern we cannot rule out the potential occurrences which are missing due to misfiling. Again in 1995 only four pesticide and medicine poisonings have been reported by the laboratory. These had happened in Nicosia. The remaining three are likely to be the cyanide poisonings which were detected and added to death certificates as well. An extra of four poisoning events, three by CO and one other cyanide are also reported belonging to other city governs of the island yet they are kept in the capital.

Table 4.6 represents the age and sex differences seen in deaths within Nicosia. 58% of the poisoning cases from death certificates were women with 18 deaths out of 31 showing variation between the ages 5 and 80 and a mean of 48. Seven of these deaths were caused by medicine uptake, direct poisoning and indirect organ failures. This number was closely followed by five pesticides, 2 Cyanide, 1 Carbon monoxide and other unrevealed poisoning through toxic substances.

In males, we see the 42% of the cases with six pesticides and a single medicine related deaths. The rest are of diversity including singular cases of Lithium, Cyanide and Carbon monoxide along with unidentified poisonings. The mean age for males is 52. Thirteen reports show that males have more of a chance to be effected by agricultural chemicals than females. Farming and other agricultural activities are

done both by males and females so the difference in exposure is likely to be during the application process. This could be due to males spending more time within the site during the application of the chemicals. Their immunities would also change the effects seen on the exposed people; in this case. In overall the female immunity appears weaker against poisonings. Despite this in many countries in the word, male population has a higher percentage in poisoning cases such as between the years 1998 and 2004, in Greece this figure is 76.1% (*Vougiouklakis et al*., 2006, pp. 321-325); between 1999 and 2008, in China 63.3% (*Liu et al.*, 2009, pp. 88-94) are male fatalities. Hence directing the reasons towards socio-economical differences as well as gender based factors.

A reverse situation for TRNC is seen in drug poisonings. We see Dioxin and Coumadin derivatives as drugs for the females yet most are simply labelled as drugs and are awaiting results from laboratories. Same is true for males. The high number for females originates from old age since the majority is above 70 years old.

In Oslo, the study conducted for 2003 for one year, shows 67% male death with a 44 mean age and of these 54% was accidental where in 36% female deaths, there is a fifty-fifty percentage for accidental and suicidal intents with a mean age of 49 (*Bjornaas et al.,* 2010, p. 13). The age range is similar to that of TRNC but the male death is observed more frequently.

These numbers for suicide depends on the preliminary examinations completed by the doctor who signed the death certificate and are not conclusive. Yet they could direct the study towards the correct discussion. Of the eighteen reports on females, three were listed as suicides; two by Organophosphates, both in their early 30s and one by a drug, above the age of 75. Unlike in females two male deaths by poisoning, at the ages of 18 and 77, are associated with suicide where one is pesticide and the other is of unknown origin for poisoning. This signifies the stress put on

females in their perhaps the busiest years of their lives where in males this stress lays on their ages which they enter the adulthood and around their middle ages.

In Nicosia it is reported that only 18 deaths are associated with alcohol and cirrhosis. Only in 2002 we notice a slight spike with five cases but other years mostly have fewer cases than that. The total number of deaths is also one of the lowest within the studied decades where there is no alcohol detection in deaths within the laboratory analyses, Table 4.5. Another point is that in the year 2009 the highest quantity of alcohol detection is observed after laboratory examinations and either none were founded from Nicosia or the results were not processed in this District Govern.

There is an extra death of a male related to alcoholism in 2011 which has not been counted in the above examination since it does not represent that year fully. Hence the year 2011 in NDG was excluded from this part of evaluations to avoid confusion in future references.

Sixteen males and two females have been recorded in these death certificates having died of alcohol related poisoning. The minimum age is reported to be 37 where the maximum is 73, both males. Mean age for males is 57 with 2002 having the most gathering. Similarly one of the two female deaths has occurred in 2002 while the other one is in 2008, at the ages of 42 and 59, respectively. The latter death and two others from males have been reported to die of Pulmonary Arrests and are chronic alcoholics. The remaining cases either are cirrhosis or alcohol coma but the notes are not specific enough to discuss. It is seen that the males have much more cases regarding alcohol. This could be due to their tendency to drink more hence damaging the liver. The high age shows most of these people are chronic users with high alcohol accumulations within their body. Alcoholism is more commonly seen in males along with the detection of alcohol in blood in the post mortem examinations.

Similarly to pesticides and medications, alcohol and cirrhosis poisonings are recorded as 40 to 18 in the laboratory and District Govern, respectively. This takes up 45% of the total, making it an important figure compared to other four cities but this fragment of the study takes alcohol detection in the laboratory differently from the poisoning and cirrhosis writings in death certificate records. The former one states that ethyl alcohol was found within the system but it does not specify whether it was the cause of death where in District Govern files, the cause of death is documented as alcohol related hence making NDG files more accurate on alcohol as a cause of death.

Two CO related cases were recorded in the death certificates when compared to 14 detections in the analyses, this represents 14.29% of the total which is of low value pointing out that most of the poisonings had occurred outside the capital and in municipalities connected to it.

Lithium as a metal is found commonly in the environment and is used in batteries, alloys and alike. Its compounds are also used in manufacturing industry hence it can easily contaminate ground water through waste and as medications used for disorders such as bipolarity. Still the metal itself and its compounds are not considered dangerous (*Costa,* 2008, pp. 962-963). The case found for this examination in the year 1999 is more than likely to be due to the acute intake of lithium rather than chronic environmental exposure since there is only one such case filed with lithium intoxication which involves a middle aged male.

In the last column of Table 4.5, ‘NA’ states the unknowns of the reports. These numbers present all of the unidentified causes of death without distinguishing between poisoning and others such as cancer. As we continue on the years the cases being sent to examinations increase. This data cannot be compared to analysis results since we cannot separate the figures according to their respective city records. Also

unlike the lab data there is no documented ‘Other’ substances which had been detected like Kerosene, Benzene or Heroin.

In the overall review of death certificates, 109 cases were studied where laboratory had 135 cases with substances detection. Yet the unidentified cases hold a large fraction of this overall and the year limitation is three years shorter compared to laboratory work hence restraining the data to be discussed.

Nicosia has more cases compared to the remaining districts. Most deaths in the capital are caused by pesticides. The number of females is higher in poisoning cases with having more suicide tendencies and males are detected to consume high amounts of alcohol leading to chronic alcoholism and their detection in analyses.

SPO reports provide us with summed up official numbers for each year from all of the five cities of TRNC. Under the ‘Deaths by Causes’ charts in SPO reports, as the years pass a steady increase in the unknown figures seen is very similarly to the high quantities of unknowns obtained from other resources where 2006 gives the highest amount. The same reasons as previously discussed still apply, demonstrating the necessity in finalizing the process as these data become the only sources available in studies such as this one. Also the ‘Suicide’ column in Table 4.4 creates an obstacle in understanding the figures fully since the real causes under suicide are not detailed. There is also a possibility that these cases are not complementary with each other and we might be looking at doubled numbers being interpreted twice. Since this amount do not exceed the recorded laboratory figures, the rest of the study will take ‘Suicide’ column as separate but unidentified cases. Without the deaths in this column and the unresolved ones under ‘NA’ division, it makes 103 deaths.

Deliberate uptake of toxic materials with the purpose of self-harming is also an important aspect of this study. In most of the cases regardless of the source we see many accidental poisonings. Most of these are not labelled as such but the lack of a

distinct ‘Suicide’ and ‘Homicide’ label on the files suggests that the majority of the cases are due to exposure of or unconscious uptake of the chemical. Homicide on the other hand is in the hands of forensics where only the Police reports can show such a verdict hence those cases remain as accidents in this study and were not specifically examined.

The suicide attempts by means of self-poisoning are seen not only in TRNC but also in countries like Sri Lanka with pesticide fatality of 10.1% within six years (*Dawson et al.,* 2010). 14.7% of the fatal poisoning in Trabzon is recorded within the study of a decade (*Birincioglu et al.*, 2011, pp. 660-663). Approximately 242 pesticide poisonings were suicide attempts observed in Japan within a four year examination (*Costa*, 2008, p. 887). TRNC reports show that suicide cases include both pesticides and medicines as a tool. Six of the death certificates of NDG which have been logged in as suicide included two pharmaceutical drugs; at least one of them being analgesics and four pesticides; two Parathion, one Organophosphate and one unknown pesticides. Two people who died of medications were above the ages of 75, three of the remaining four were in their early 30’s and the last one was listed as a teenager. Having heavy medications at their disposal already, the elderly chose to commit suicide by medications where the pesticides which are easier to access were chosen by the younger. The numbers are underestimated since in the initial states of certificate preparing the substances of interest are not efficiently identified and can only be added after the analyses are complete. On this matter, the attempted suicidal purposes in the article by Sümer (2011, pp. 234-240), were of female sex and this was related to the reason of sentiments of this sex where a parallel happening was detected in Cyprus. These cases although they were not all female, the most were. In TRNC on the other hand the 26 deaths within twenty-two years show a mixture of both sexes demonstrating an increase in variety as the age progresses; Table 4.4. NDG states that there are three females and two males who committed suicide.

The article “Suicide in Cyprus 1988-1999” by Zacharakis (2005, pp. 110-114) investigates the cases which have been deemed as suicides after a routine examination process where the most suicides have been committed by males above the ages of 75 and between the ages of 15 and 24 for females. As explained in the article methods included poisoning by solid and liquid substance which was preferred by males and the second choice for females. Similarly all six of the logged substances above are solid or liquid in the suicides. There are no reported reasons for these cases in TRNC but it is possible to be parallel with the ones in the southern side of the island just as stated in the article

> Underreporting might be one of the reasons for the very low suicide mortality in Cyprus. The extent of underreporting, even though unknown, is most probably limited, due to the small size and close relationships that characterize the population under study. Social and cultural factors may contribute to the very low suicide rates in Cyprus… Factors such as the small size of the population, the short distances between communities, the long history of the nation and the cultural uniformity of the population also contribute to the low suicide mortality observed, as in other countries (*Zacharakis et al.*, 2005, pp. 110-114).

When observed as a whole the total amount, 602 cannot directly be compared to the laboratory results where some of these deaths are not poisoning related. When the 40 alcohol deaths of laboratory are compared with 66 alcohol cases of the SPO, it is seen that other than the three specifically labelled alcohol comas, 37 of the SPO total could be alcohol poisoning related which represents a high percentage. Whether the death was directly caused by alcohol influence on the person or as a mediator linking it to another cause, the value still proves to be a notable portion of the study. Having no identified data after 2003 prevents us from charting the developments over the years. After 1997, the numbers continue to decrease in the column and when the NDG is checked, Cirrhosis cases are seen within the death certificates for the same years. Possibly these cases were listed as unknowns or suicides in SPO rendering it impossible to discuss their true nature.

Across the world though there are examples which can be compared and in the article “Epidemiology and alcohol policy in Europe” by Rehm (2011, pp. 11–19), he gives an idea on the variations of alcohol impacts within regions saying Cyprus as an eastern Mediterranean country has a lower percentage of drinkers hence lower alcoholism problems.

> The global picture hides considerable variability in the effects of alcohol. Large regions of the world, such as the Islamic countries in the southern and eastern Mediterranean region and in the Near East, have abstainer rates of more than 90% or higher, and very little alcohol attributable harm. Conversely, the European region has the highest impact of alcohol, with about 6.5% of the deaths (men: 11.0%; women: 0.8%) and 11.6% of the DALYs (men: 17.3%; women: 4.4% [1]) attributable to alcohol (*Rehm et al.*, 2011, pp. 11–19).

Here we also see that alcohol consumption by males is higher than females. When compared to other countries no matter how small alcohol consumption appears in TRNC, it still is a considerable danger with direct or indirect effects on people.

The ‘Poisoning’ column of Table 4.4 shows that there is a wide range in ages of the reports where the substance is not always known. Up until 2006, we see no correlation between the age groups. According to this, poisoning occurred most commonly between the ages 35 and 44. Five of these reside in Nicosia District and the peak is consisted of the ages above 75 with eight cases that has died of poisoning in the capital even if there are only four reported in SPO. The age group 2-14 does not appear at all but in NDG files we see two deaths of those ages. Out of 37 deaths in general at least 31 of them lived in the capital city. If missing files on both resources are disregarded, the cases appear most abundant in Nicosia due to the capital’s high population and large market. This provides easy accessibility for purchasing substances of interest.

The substances are mostly identified in the death certificates but SPO is limited on this subject with displaying only statistical data and no background information similar to that of laboratory data. When combined with these data the

information is not consistent enough to be certain but it directs the study with displaying irresponsible application of chemical substances. Although poisoning does not appear to cause as much deaths as others, when observed within the annual death reports, the pesticides are the most common chemicals in the detailed resources, death certificates and laboratory analysis'.

A major part of the individuals tend to include children and teenagers in poisoning cases. Both accidental and suicidal reasons are observed in such events and it represents a key part in examinations. Death rate is given as 0.4% in children in Turkey (*Sümer et al.*, 2011, pp. 234-240). There are nine deaths including children and teenagers in TRNC, a remotely low number on its own but within the total poisonings it covers 24.32% marking its significance.

According to a study conducted on Greek population of Cyprus by Koliou (2010, pp. 833-838), medications were the most frequent substances for poisonings among children; Paracetamol being second to that and pesticides standing on the lower levels of the chart. The article studies on the morbidity and no data was presented on fatalities. Since the authors focused on a three year study, it is possible that there were no deaths recorded in the hospital within that time. Where it represented children up to fifteen years old, the statistics were limited to a single hospital records showing high percentage of accidental poisonings. The majority of the poisoning cases were of children under five years old. In northern part of island however the only identified children cases which were found in death certificates included accidental cyanide poisonings due to consumption of the apricot seeds. The ages of these children were between 2 and 10, displaying a lack of education on their side since the children would not know of the toxic substance in the fruit.

The vast number in medication poisoning, mainly Paracetamol and cardiovascular medications, is due to the presence of drugs found in the houses where they are easy to access by children. The pesticide poisonings on the other hand

are of lower repetition since the children who play outside are not as much affected as a grown adult who would be working with these chemicals. The major difference between the two sides of the island is that the Greek part is a part of the European Union regulations hence the control over pesticide application is intact whereas in north side, the accumulation of chemicals in the earth is more consistent due to the lack of sufficient control over the market.

A similar research on children was conducted by Sümer in his article (2011, pp. 234-240) in Turkey. Like the previous one the study showed that the most common poisoning cases occurred within the ranges of 1 and 14 years olds with medications and caustic-corrosive household products as the main source of toxicity. No death cases were examined in this article but the death rates in the emergency room administration due to poisoning was given as 0.4%. Sümer also stated that the exposure routes were mostly through ingestion and inhalation, giving a high percentage of accidental occurrences by 97%. The main medication poisonings were due to antidepressant and organophosphate uptake.

Besides pesticides and medications according to the article by Koliou (2010, pp. 833-838), household and cleaning products as well as petroleum products poison children. They mostly represented the accidental uptake of substance where the medications were used for suicidal attempts.

A study on drugs was conducted in Sweden by Jönsson et al. (2009, p. 7) discussing the mortalities of pharmaceutical drug poisonings. In the article it is said that of the 1574 death certificates 12 of them stated death by pharmaceutical drug poisonings and 10 of those were classified as such when their medico-legal files were checked. This data represents an annual death toll of Swedish population during 2001 where benzodiazepines, anti-histamines and analgesics have been seen most commonly. TRNC records of the same year state there was one case of chronic substances abuse in Nicosia District and no other known case was related to drug

use. In general antidepressants were detected most in the medications type as seen in Table 4.3. Therefore pharmaceutical drugs can also pose potential risks which can escalate in the future and necessary precautions should be taken before it does in order to prevent any damage that can be done by these chemicals.

Despite these obvious dangers of the medications, pesticide application still remain as the dominant problem in poisoning cases within TRNC. Agricultural chemicals have been a threat to human health in many parts of the world including Sri Lanka, a country locating on a tropical island. The study conducted by Dawson (2010) carries the importance of displaying the deaths, mainly suicides and suicide attempts by pesticide poisoning figures after the submission of restrictions over certain agricultural chemicals as well as providing new data on human toxicity and how investigating this will help in aiding the reduction in such cases. Its article investigates and assesses the development through the twenty years while examining the fatalities; the pesticides in effects and in results. It also gives useful information and comparison between the researched chemicals and their respective WHO classifications.

This article is studied for the purpose of showing the decrease in poisonings because of the adjusted regulations; Class II and III of WHO classifications are the only ones allowed in Sri Lanka compared to twenty years ago yielding results as 9,302 patient admissions with deliberate pesticide uptake where they could be identified in 7,461 cases and the rest remains unknown. Also the suicides take up of 10.1% in fatalities. Later it argues the results as;

> The potential effect on mortality of banning the three most lethal pesticides and assuming best and worst case substitutions suggests a reduction in overall pesticide case fatality of between 33% and 65%. The actual fall in case fatality seen after withdrawal of these pesticides will therefore depend substantially on which pesticides replace them in the market (*Dawson et al.*, 2010).

The statement shows that if such control is ensured in TRNC, the pesticide poisonings would diminish considerably very similar to that of Sri Lanka's. In other countries such as Greece which is considered as a developed country, we see that drugs of abuse are detected more than pesticides. In Vougiouklakis's study (2006, pp. 321-325), drugs were the substances causing the most deaths, a common occurrence in Western Countries. Pesticides, organophosphates and carbamates were only second to these drugs. The developed countries have control over the pesticides but other problems causing poisoning still rise. Yet this is one study that shows developing countries are subjected to poisoning by agricultural chemicals more than that of developed countries.

Pesticides alone are not responsible in environmental toxicity caused by the chemicals. Factors such as seasonal changes also effect the pesticide contamination. Taking a study period of six years, Sümer (2011, pp. 234-240) had examined the seasonal changes in his study. Despite being a non-port residence the study's focus city Kahramanmaraş, is similar to Cyprus in seasonal changes and we could expect the summer and spring to create more acute poisoning cases than the winter where children is more likely to spend time outdoors, being affected by the environmental chemicals such as pesticides on earth.

As well as Sweden's own fatality of 0.57% per 100 000 person-years in the general population, other countries' are also included in Jönsson's (2009, p.7) such as Iceland with 0.35 and Finland with 0.54 per 100 000 person-years from hospital records and Canada with 2.5 and Greece with 0.1 per 100 000 person-years from forensic files. Authors relate these changes to geographical and resource differences while stating the limitations which are similar to this study's own as;

> The concentrations can vary between sampling sites, and may change over time, particularly at high ambient temperatures… One limitation of the present study is its retrospective design. Despite scrutinising the medico-legal files, medical charts, police reports and additional sources of information, it is

> impossible to obtain all relevant information in each case; hence the number of drug poisonings might have been underestimated. Moreover, the number of fatal poisonings observed in the study is limited… Benzodiazepines, antihistamines and opioid analgesics were most commonly associated with fatal poisonings in this study but the numbers in each group were small. The substances detected may reflect their inherent toxicity, but also their sales and overall use, which vary between geographical areas (*Jönsson et al*., 2009, p. 7).

These limitations also restrict the figures and only estimation can be done lowering accuracy.

When compared with the laboratory results a large difference between the figures of the SPO and laboratory can be seen. In a more general look NDG reports with seven and laboratory analysis with eleven cases present their case numbers at their peaks in the year 1995. We know there are four pesticides and another seven other poisonings detected in laboratory. Certificates from the Capital District give two pesticides and four other poisoning cases. Three Cyanide and one CO cases along with one Dursban, the 'II' class and one Methyl Parathion, the 'Ia' class organophosphate poisonings were all found in the two sources validating their data in the Nicosia District. However SPO shows irregularity at this point, in 1995, it only has three poisoning cases and the peak number is seen in the year 1994 with nine of them. Laboratory only has four recorded analysis hence the rest must has been acquired from outside the island, probably from Turkey.

Table 4.4 depicts the correlation between annual deaths and the causes; within these files death by poisoning do not hold a major thread since the most occurrence is due to senility and cancer according to the SPO data (*SPO*, 2008, pp. 32-33). Yet in a country as small as TRNC even a single case could pose a thread, like a death caused by popular brand of pesticide usage. Before the authorities could even pinpoint the cause and identify the pesticide, the brand would be distributed and applied by the farmers. Post mortem and toxicological results will provide a solution but until the chemical is properly banned from usage it will continue to be applied.

The introduction and marketing of the pesticide would be fast but retrieving it from the stores would be a time consuming task and clearing it from the environment would take even longer. The WHO classification or any internationally acceptable systems for pesticides are not in use in the island. This lets the ‘Ia’ class pesticides to remain in the market freely, accelerating the process of contamination. The more these chemicals are let into the environment, the harder it gets to prevent the poisonings. As the types being used increase due to non-prescribed purchasing, the chemical accumulation will eventually increase and it will spread further than the agricultural sites risking lives even in urban areas areas and not just rural ones.

6. CONCLUSION

Humans interact with many substances during daily life which have potential to be poisonous. Where the toxicity levels of these substances differ greatly, some affect us more than the others through chronic or acute exposure. The uncontrolled market and application of agricultural chemicals, the medications given out and being kept in houses where anyone can access are only a few reasons which lead to poisoning occurrence in TRNC as well as increase the risks of toxic contamination in the environment.

With this study it can be seen that the insecticides are the most common cause of poisonings in regards with heavy pesticide usage within the agriculture between the years 1991 and 2012. Methomyl, a highly hazardous carbamate, despite being fairly new in the market has been detected most frequently. Having 56.71% farming area available in TRNC, it allows for extensive cultivation activities with excessive pesticide application. The lack of regulations over these pesticides results in dangerous and excessive usage hence cause significant chemical exposure to people and the environment. In regards with this, pesticide poisoning occurs more repeatedly.

Second to pesticides are the alcohol related deaths. Including chronic alcoholism based cirrhosis, alcohol induced accidents and comas. Traffic accidents due to excessive alcohol consumption are encountered regularly and even if it cannot be said which of these causes are the main reason for death, alcohol still makes a heavy impact on death by direct and indirect poisoning.

Medicine is not as common as pesticides in poisoning cases and antidepressants are the pharmaceutical drugs seen most in these few available cases. Similarly Carbon monoxide, Cyanide and other substances detected are only observed in a small number of cases.

Many of the deaths, where they had been recorded as such are accidental and suicidal poisonings. Accidents are the majority in the intents with pesticide poisoning and suicide is attempted with both medications and pesticides. The poisonings are seen the most between the age range of 35 and 55.

The capital of the island is studied separately from the island's general examination due to its high population and to the fact that it has both rural and urban regions in a small area as well as having the largest market which provides the widest and easiest accessibility to the substances of interest. In the capital, Nicosia there is a distinctive increase in the number of cases. Within the 33.03% of the population, approximately 44.93% of the cases originate from Nicosia, pesticides being the main cause of death. 58% of these deaths are of women. The majority of the substances detected in both males and females are pesticides. As to why females are more easily poisoned, having weaker immunity systems could be an answer but this cannot be given as a certainty since immunity changes from people to people and between genders. Thus its reason remains as an unknown.

When the missing files and disorganized records are coupled with inability to perform all of the analyses in the island, we are faced with a number of limitations which restrict the data available to study and diminish the figures to a rough estimate with still ongoing investigations on these cases. Nevertheless even without the remaining unidentified deaths, poisoning with its high lethality levels, prove to be a danger both to the people and the environment. Without the necessary education and control over the application of many chemicals and substances, poison poses life threatening risks due to its easy and fast dispersion over the island in cases of excessive usage.

For better analyses, an important precaution lays with keeping proper and ordered records under the governmental departments. If all of those are stored under a well-structured, single department and summed up accordingly with the help of

online and electronic devices, the data would be easier to collect and study. Hence this will allow faster investigations with regularly dispatched information for the public and increase awareness among the people, helping them regulate applications of these substances and decrease the chemical exposure. This will then help reduce the number of fatalities caused by poisonings.

Further studies on this subject can be conducted with monitoring the rest of the year 2012 and the next few years in order to form the missing correlations. Both theoretical and practical studies are needed to grasp the full situation of poisonings in TRNC such as detailed laboratory analyses on cases including not only deaths but also cases with non-fatalities. Despite the bans, there are still many dangerous chemicals allowed in the island, especially in the agriculture and the already contaminated environment can be examined in assessing the exposure levels. A continuation of this study would provide a clear idea on the mortality caused by poisonings in the future; assist in formulating counter measures and treatments against poisoning by both the government and the public as well as raise sentience on prevention of poisonings. Where it will consume time to clear the environment from the chemical contamination which has already accumulated in the earth, it will be a step taken in reaching a vibrant and poison free country.

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ADDITIONAL

ADDITIONAL 1: Thesis Survey for Nicosia District Govern

Case No:

Group:

Time of Death: Age:

Location of residence: Sex:

1. Address for the information;		
District Gov.;	Police;	Other;

2. Cause of death;			
Poisoning;	Substances of Abuse;	NA;	Other;
Homicide	*Alcohol uptake*		
Suicide	*Addict – drugs*		
Accidental			

3. If poisoning, it was caused by;			
Drug/medication;	Food;	Ethyl Alcohol;	Methyl Alcohol;
Pesticide;	Cleaning Products;	Mushrooms;	Other;

4. If poisoning by drug by which;		Market name?	
Benzodiazepine;	Opiates;	Narcoleptics;	Antidepressants;
CVS drugs;	NSAID, analgesics;	Other;	

5. Type of poisoning;	Acute;	Chronic;

6. Exposure route;			
Oral;	Parental;	Inhalation;	Other;

7. If poisoning by alcohol by which?
Market name?
Chemical Composition?

8. If poisoning by pesticide;		Product name;	
Application location;			
Agricultural;	Garden;	House;	Other;
Purpose of usage against;			
Mosquitos;	Mice;	Birds;	Snakes;
Vermin;	Other;		

9. Death by malpractice- medical application error;
Drug?
Health Care personnel; if so what was their status?

10. P.S: