A STUDY TO INVESTIGATE THE IMPACT OF LEAD PELLET TO THE AIR PISTOL AND AIR RIFLE SHOOTERS HEALTH IN SUBANG NATIONAL SHOOTING RANGE

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A STUDY TO INVESTIGATE THE IMPACT OF LEAD PELLET TO THE AIR PISTOL AND AIR RIFLE SHOOTERS HEALTH IN SUBANG NATIONAL SHOOTING RANGE

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ABSTRACT

Handling of lead pellets among the Air Pistol and Air Rifle shooters are the potential risk that may have adverse effect on the shooter's health. In shooting course of action, shooters need to physically handle lead pellet, susceptible to inhaling the lead dust or fume and the improper ventilation system may increase the lead contaimination in the shooting range. Limited of empirical evidence focusing on the lead pellet effect to the shooters has created some difficulty to the researcher to complete the research. The reseach was conducted among the Air Pistol and Air Rifle shooter in the Subang National Shooting Range with the objective to the determine the contributing factors i.e physical contact, inhalation and ventilation system that may have impact to the shooter health status.

Keywords: Airgun, Air Pistol, Air Rifle, ISSF, Lead.

ABSTRAK

Pengendalian dan penggunaan pellet oleh penembak Air Pistol dan Air Rifle mendedahkan mereka kepada risiko yang negatif kepada tahap kesihatan mereka. Setiap penembak perlu secara fizikal mengendalikan pellet, risiko terdedah kepada menghidu debu atau gas timah hasil daripada tembakan pellet serta pemasangan dan fungsi sistem ventilasi yang tidak sempurna pada lapang sasar menjejaskan tahap kesihatan penembak. Sumber rujukan yang terhad di dalam mendapatkan bukti-bukti faktor tersebut menyumbang kepada risiko kesihatan penembak merupakan kekangan utama yang dihadapi semasa menyiapkan kertas kerja ini. Skop kajian meliputi penembak Air Pistol dan Air Rifle di Lapang Sasar Kebangsaan Subang dan sebanyak 80 kertas soal selidik telah diagihkan bagi mendapatkan maklumbalas mengenai hubung kait pengbolehubah yang dinyatakan di atas pada tahap kesihatan penembak.

Kata kunci*:* Airgun, Air Pistol, Air Rifle, ISSF, Plumbum.

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ISSF	**International Sport Shooting Federation**
NSAM	**National Shooting Association of Malaysia**
OSHA	**Occupational Safety and Health Act**
FMA	**Factory and Machineries Act**
NIOSH	**National Institute of Occupational Safety and Health**

CHAPTER 1

INTRODUCTION

1.1 Introduction

Lead is a toxic agent and it is classified as hazardous and one of the oldest established poison which has negative impact to the human health. There are many studies conducted by the researchers to determine the level of effect lead can brings to the human's health. Some researchers such Theodore I Lidsky and Jay S Schneider (2003) tried to identify the hazardous effect of lead to the children that may impair their cognitive development. However, human still opted to use lead based substances despite the potential hazards associated with it.

National Safety Council (2007) defined lead as the highly toxic and contributes to adverse health effect to human being. There are many way human would be exposed to lead. Agency for Toxic Substance and Disease Registry (2007) in its fact sheet identified the typical exposure to lead comes from breathing workplace air or dust, eating contaminated food or drinking contaminated drink. The direct exposure to the lead would be hazardous to the health and could cause permanent damage to the brain. Since the usage and exposure to the lead related substances have accumulative effect on the one's health, thus necessary steps need to be considered in order to mitigate it effects to those who have direct contact with it.

Lead adverse effect to human varies depending on several factors namely age factor, gender and period of exposure to the lead substances or agent. Agency for Toxic Substances and Disease Registry (2007) revealed that long term exposure to lead among adults would definitely affect the nervous system and the performance. To certain extent at high level of exposure of lead would create the kidney and brain damage which eventually leads to death. In addition to that, some of western researchers had identified that among the health problems created by lead contamination are digestive problems, kidney failure, fatigue, irritability, joint pain, memory problems, nervous system and reproductive system damage. Gary Dessler (2005), on the other hand has identified lead as one of the major sources contributing to the occupational respiratory diseases among workers at the workplace. Alwi Said (2011) proposed that among the alternatives to reduce such effect namely; observe the permissible exposure limit, conduct of assessment risk, take necessary steps to control and eliminate hazards and conduct the monitoring of employee exposure.

Shooting activities is one of the activities which have the risk of lead exposure. Air gun shooting particularly in the Air Pistol and Air Rifle events is among the activities that have direct exposure to lead by virtue of using the lead based pellet in as the main ammunition or projectile in the shooting processes. In addition to that, the shooting activities for the Air Pistol and Air Rifle shooters were conducted in the indoor shooting ranges which required proper ventilation system to dilute the contaminated air produced by from shooting activities and circulated fresh air to the ranges users. Many researches were conducted to determine the level of lead exposure among the air gun shooters. However, researchers are varies in their opinions whether such activities really contributed to the lead exposure to the

shooters in the range. According to Sanna Asa Makinaiplae et al. (2009), the shooting activities with lead based ammunitions especially in the indoor shooting range are susceptible to expose people to lead. In addition to that, direct exposure to the airborne particle, fume and settled dust has put the shooter to the risk of lead poisoning. This arguments furthers supported by Mark Boeniger and Susan Puskas (2008), whereby their research among 29 shooters in two different ranges have had shown that using firearms are the source of lead exposure and results in appreciable loading of lead in the hand of the users. On the other hand, there are some researchers who believe that such activities do not contribute to lead contamination among the shooters. Robert Mitchell (2008), the Chief Executive Officer to US Olympic Complex, reported that based on his environmental sampling in the indoor shooting ranges showed that the ambient air sample and floor sample under study did not contain lead and asserted that indoor shooting range are free from lead exposure. Some of the study concluded that airgun shooters irregardless of age do not face any health risk from airgun shooting activities if they follow proper hygiene practises and the shooting range is properly managed.

There are many studies conducted by previous researchers to determine the level of lead effect to the shooters. The studies were conducted either in the indoor shooting range and the outdoors shooting range. Some perceive that indoor shooting are susceptible to lead contamination risk since the shooting activities are conducted inside the building which requires proper ventilation to circulate the fresh air and dilute the contaminated air. As stipulated in the report release by the Safety and Health and Research Prevention (2000), an effective ventilation system is a medium to reduce the airborne lead exposure in the indoor firing range.

The availability of the firing ranges in Malaysia is quite small in number since the shooting activities is not quite popular sport activities and regarded as expensive sport to venture in. Subang National Shooting Range is one of the biggest shooting ranges in Malaysia which provides the facilities to the sport shooting enthusiasts to exercise their shooting activities. Most of the shooting activities and competition were conducted in this range which comprises of several ranges including both indoor and outdoor shooting range. In Subang National Shooting Range, the indoor shooting range was designed for the 10 meter Air Pistol and Air Rifle event. On the other hand, the outdoor shooting range is design for any shooting activities that used 0.22 calibre ammunition or larger calibre and it can be divided into 25 meter outdoor shooting range and 50 meter outdoor shooting range.

The housekeeping of the indoor range is another factor that needs to be look into, to mitigate the risk of lead exposure the air gun shooters in the firing range. Proper ventilation inside the range and the proper usage of the air pellets are mandatory to prevent the legitimate risks associated with the lead based projectiles. In Malaysia scenario, it is observed that there no proper guideline provided by the relevant safety and health agency regarding the safe conduct or the prevention of lead exposure to the shooters. However, it was reverse in the Western countries, whereby proper guideline was established to ensure the potential shooters to the range are making known about the potential hazards that they will facing when they engaged in the shooting activities (OSHA, USA).

Given the possible hazards of lead exposure to the Air Pistol and Air Rifle shooters, this framework has generally try to establish the possible health effect facing the Air Pistol and Air Rifle shooter in the Subang National Shooting Range. Briefly, the framework proposes the relationship between the potential hazards i.e. handling the lead based air pellets, inhaling the lead fumes or dust particles, and ventilation system and the health effect of the shooters.

1.2 Background Of The International Shooting Sport Federation (ISSF) Shooting

International Shooting Sport Federation (ISSF) is the governing body and sole controlling authority for the sport shooting activities and responsible for promote and guide the development of shooting sport worldwide. ISSF Rules Book (2013) has categorised sport shooting activities into three discipline namely pistol discipline, rifle discipline and shotgun discipline.

ISSF Pistol discipline comprises of several categories that uses different type of pistols and ammunitions ranging from air pistol to small bore pistol. Pistol discipline is subdivided into several events such as 10 meter Air Pistol, 25 meter Pistol, 25 meter Standard Pistol, 25 meter Centre Fire Pistol, 25 meter Rapid Fire Pistol, 25 meter Sport Pistol and 50 meter Free Pistol. Air Pistol event is consider the basic shooting which stressed on the fundamental of shooting. It uses the air compressed and CO2 that provides pressure to burst the 4.5mm or 0.177 inch lead pellet to the 10 meter target. Whereas, the rest of the pistol shooting events may use the 0.22 calibre

and 0.32 calibre bullet for all the shooting activities. Figure 1.2 below shows the typical air pistol used by the shooters during air pistol training and competition.

Figure 1.2
Air Pistol

The ISSF Rifle discipline is further subdivided into several categories namely 10 meter Air Rifle, 50 meter Prone Rifle, 50 meter Three Position Rifle, 300 meter Standard Rifle and 300 meter Rifle Event. 10 meter Air Rifle event is normally the most basic and air compressed and CO2 as pressure to burst the air pellet to the target. The typical air rifle gun used in the Air Rifle event is illustrated by the Figure 1.2 below:

Figure 1.3
Air Rifle

Meanwhile shotgun discipline covered three events namely trap, double trap and skeet event. According to ISSF Rules Book (2013) shotgun definition covers all

types of smoothbore shotgun including the semi automatic and use the 12 gauge or lesser as the ammunition.

Ammunition used in the ISSF sport shooting are varies ranging from pellet - lead based projectile, 0.22 calibre bullet (point two two), 0.32 calibre bullet and cartridge. The most basic shooting event the Air Pistol and Air Rifle event may used air pellet as the ammunition to shoot to the paper target at the range of 10 meter. The lead based pellet is 4.5mm or 0.177 inch in diameter are used by each shooter in these events and placed in the breech of Air Pistol or Air Rifle. Normally Air Pistol and Air Rifle event are conducted in the indoor shooting range equipped with necessary equipment and ventilation system approved by authority. However in more advance events, particularly in the 25 meter Pistol Events and 50 meter Rifle Events, the ammunition with 0.22 calibres or 0.32 calibres will be use by the shooters.

In Malaysia, all the ISSF sport shooting activities is governed by National Shooting Association of Malaysia (NSAM). Presently NSAM is located in Subang National Shooting Range and it responsible to control and promotes the ISSF sport shooting activities to Malaysia. Being the national body that governed the ISSF shooting, NSAM has regulated certain rules and procedures to ensure safety to the shooters and other user of the range. Basically, there are many facilities available in Subang National Shooting range including the swimming poll, squash and tennis court, club house, an indoor shooting range for Air Pistol and Air Rifle shooting activities, 25 meter outdoor shooting ranges for pistol event, a 50 meter outdoor shooting range and an outdoor range for Shotgun shooting activities.

As mentioned by Eric Lawrence and Mike Pannone (2009) in Tactical Pistol Shooting, they had stressed the important of safety issue when dealing with weapons. According to them safety is one of the critical aspects of hand-gun training and reckless handling of weapon would be disastrous to the shooters. Thus, to enforce safety in the shooting ranges, certain rules and regulations pertaining proper use and handling of weapons in the shooting were established. However, most of the regulations formulated are very much focused to the safety aspect of handling the weapon and projectiles or ammunitions in the range and health issue associated with the uses of weapon and projectiles in the shooting range is not properly addressed by the shooting association. From researcher observation and experience dealing with Air Pistol and Air Rifle shooters in the Subang National Shooting Range (NSAM), it is observed that there were no proper awareness program regarding the potential risk associated with handling or exposure to lead and are no written lead safety management guidelines found were produced or disseminated by the association to the airgun shooters in the range. On the contrary, in the Western countries particularly in the United States of America, they have provided comprehensive health and environment guideline regarding the used of lead pellet in the indoor shooting range.

Subang National Subang Range is the central place for any ISSF shooting activities in Malaysia where it becomes the main venue for the National Shooting Circuits Championship to be conducted. Normally there are six major circuit conducted each year namely Selangor Shooting Championship, NSAM President T.H Ong Trophy, Tun Hanif Omar Trophy, Tun Tan Siew Sin Trophy, Chia Woh Trophy and National Shooting Championship. During those periods of championship, most all States

Shooting Association as well as Malaysian Armed Forces Shooting Association and Royal Police Shooting Association would gather at Subang National Shooting Range

1.3 Background of the Study

Lead related substances have negative impact to the individual health that has direct contact or inhaling the lead dust and fumes or lead from lead contaminated hand, equipment or clothing. Shooting athlete is exposed to the lead in the indoor shooting particularly through the positive contact with lead pellets uses as the ammunition for the shooting activities. During the shooting processes, the shooters are at risk of inhaling the lead dust or particles created during the discharging of weapon. Such prolong and continuous processes would expose the shooter with negative health effect. This study is concentrated to two major shooting events particularly the Air Pistol and Air Rifle event of the ISSF shooting activities in the 10 meter indoor shooting range. Along with the weapon uses in the event; Air Pistol and Air Rifle, shooters are require to handle the pellets or ammunition particularly 4.5mm or 0.77 calibres lead made substance as the bullet for the shooting activities. The possible risk to the shooter is to have in contact with the lead made pellet and the possibility of inhaling the pellet dust particle discharge during the shooting process. Most of the shooting activities are conducted in the indoor activities fitted with necessary air conditioning to provide comfort to the shooter during training or competition. However, the air circulation and the permissible level of lead within the indoor range are questionable and need further study to determine whether it is within the permissible level of use to all the shooters.

1.4 Problem Statement

According to statistics from Health and Safety Executive (2012), medical surveillance of lead blood level among British workers had shown that there was an increase in the number of workers who went under medical surveillance which is 6% from 7,472 in 2010/2011 to 7,945 in 2011/2012. The increase in the number of the workers went under medical surveillance shows the concerned among the employers regarding the risks of leads exposure to the workers.

Shooting are one of the activities that has direct use of lead. As mentioned by Chang Kah Haw et al. (2010) had identified that firing gunshots can contributed to the release of lead dust or lead particle. Airborne lead particles which are exposed to the shooter can effect negatively to the shooters health. In Malaysia, the total number of airgun shooters are limited in number due to the strict procedure impose by Malaysian Government to those who intend to own a handgun. According Mr Subramaniam, Executive Secretary of National Shooting Association of Malaysia (NSAM), it is estimated that 200 active Air Pistol and Air Rifle in Malaysia who are registered with the Association.

Air Pistol and Air Rifle shooters conducted their shooting activities in dedicated indoor shooting range which is equipped with proper ventilation system to circulate the fresh air to the area. Based on the researcher observation in the Subang National Shooting Range, most of the Air Pistol and Air Rifle spend more three hours in the indoor shooting range for their training. Such frequent and longer hour spend in the range would therefore expose the shooter the toxic and hazardous vapours produced during the firing practises (Chang Kah Haw et al. 2010).

This study focuses on the relations between the ISSF shooting activities and its adverse effect to the health of the shooters in particular Air Pistol and Air Rifle shooters in the indoor shooting range of the Subang National Shooting Range. Most of the literatures used in this research were adopted from the studies conducted from Western Countries since little study has been conducted and published on the subject matter in Malaysia.

1.5 Research Questions

This research is an attempt to examine the relationship between the independent variables which are the external factors and the dependant variables of shooter health status. This research is to uncover the relationship between the shooters health status over any of the contributing factors that includes 1) direct contact with lead based pellets, 2) inhaling of lead fumes or dust particles, and 3) availability of proper ventilation system for the indoor shooting range. Thus this study would determine the component of the contributing factors would have the adverse impact on the shooters health.

1.6 Research Objectives

The objectives of this research seek to understand the following:

1. To examine the relationship between direct contacts of lead based pellets and shooters health effect.

2. To examine the relationship between inhaling of lead fumes or dust particles and shooters health effect.

3. To examine the relationship between ventilation system and shooter health effect.

Based on the above objectives, the present study seeks to test the following hypothesis:

H1: There is relationship between direct contact with lead based pellet and health effect of Air Pistol and Air Rifle Shooters in Subang National Shooting Range.

H2: There is relationship between inhaling of lead dust or lead fume and health effect of Air Pistol and Air Rifle in Subang National Shooting Range.

H3: There is relationship between the availability of proper ventilation system and health effect of Air Pistol and Air Rifle shooters in Subang National Shooting Range.

1.7 Significance of Study

This study would give the International Sport Shooting Federation (ISSF) sport shooting enthusiast particularly to Air Pistol and Air Rifle shooters on safety awareness to the significant factors that would have the negative impact on their health such as the potential hazard of handling of lead pellet and inhaling the lead fumes or lead dust particles, proper ventilation system in the indoor shooting range.

Additionally, this study could provide the National Shooting Association of Malaysia (NSAM) with additional information that can be further use to inculcate the awareness among the shooters regarding the hazards of lead exposure during their conduct of shooting activities in the range. It is hope that such information and knowledge available to the shooter would reduce the likelihood lead poisoning or lead contamination to the shooters.

1.8 Scope of the Research

There are many shooting discipline in the sport shooting activities. However this research is only focused on the Air Pistol and Rifle discipline which are considered the most basic shooting discipline compared to the others. In contrast to other shooting discipline, Air Pistol and Air Rifle shooting discipline use the projectiles known as pellet which is produced from lead and the rest of shooting activities use bullet as the ammunition. It is estimated that there is 200 Air Pistol and Air Rifle shooters registered with the National Shooting Association of Malaysia (Mr Subramaniam, Executive Secretary of National Shooting Association of Malaysia). Such a small number in the population Air Pistol and Air Rifle shooters in Malaysia was due to the limited perception among Malaysian whom believe that sports shooting is the expensive activities to involve in and require them to possess a shooting licence before the can start with shooting activities. However, with the existence of new talent or talent scoping program conducted by National Shooting Association (NSAM) and Selangor Shooting Association (SSA), the sport shooting activities becoming more popular sport among the youngster.

This research had focused on the Air Pistol and Air Rifle shooters who conduct their shooting activities in Subang National Shooting Range, Shah Alam, Selangor. The research was conducted during the period of National Shooting Circuit Championship which was held during the period March to June 2013. The composition of the shooters under study ranging from shooters from States Shooting Associations, Malaysian Armed Forces Shooting Association, Malaysian Royal Police Shooting Association and National Shooting Athlete from Malaysian Sport Council (NSC). The aim of this study is to determine the potential impact of lead based pellet to the Malaysian Air Pistol and Air Rifle Shooters.

A total of 80 questionnaires were distributed to 80 respondents. The respondents were the Air Pistol and Air Rifle shooters whom conducted their preparation training and involved in the National Shooting Circuit Championship during March until June 2013.

1.9 Limitation of the Study

During the time conducting the study, the researcher faced a few problem and limitation as for the following:

1.9.1 Availability of Data

One of the challenges facing in conducting the study is the availability of data to support the research. Most of the information was obtained from journals and the book references from the library were limited. In addition to that, the available

references were mostly focused on other discipline of shooting, and less research were conducted in particular to Air Pistol and Air Rifle Shooting discipline. Similarly, there is no documented study conducted locally that can use by the researcher to support the study. It is hope that proper clinical study can be done in the future to investigate the impact of lead usage to the Air Pistol and Air Rifle shooters.

1.9.2 Time Constraint

Time is an essential element in collecting the data for this research. Four months time period to gather all the necessary data would be a great challenge for the researcher to complete the study. However, with proper time management researcher manage to allocate time to collect the data from all the respondents in Subang National Shooting Range during the Malaysian Shooting Circuit period.

1.9.3 Lack of Study Experience

Researcher lack of experience in conducting the research in the field is another contributing factor that has effect the completion of this research. Such experience could therefore be developing through learning process and assistance from several people that involved directly in completing this research paper. The limitation requires the researcher to work extra miles and more times need to be sacrifice in fulfilling this research requirement.

1.9.4 Limited Scope of Study

The scope of the research is confined to the Air Pistol and Rifle shooters in who practise and involved in the National Circuits Shooting Championship in Subang National Shooting Range. The research does not include any other ISSF shooting activities as part of the survey and study.

1.10 Hypotheses

Following are the hypotheses developed for the research:

Variable 1: Direct Contact

Hypotheses 1: There is relationship between direct contact with lead based pellet and health effect of Air Pistol and Air Rifle Shooters in Subang National Shooting Range.

Hypotheses 2: There is no relationship between direct contact with lead based pellet and health effect of Air Pistol and Air Rifle in Subang National Shooting Range.

Variable 2: Inhalation of Lead Dust or Fume

H1: There is relationship between inhaling of lead dust or lead fume and health effect of Air Pistol and Air Rifle in Subang National Shooting Range.

H2: There is no relationship between inhaling of lead dust or lead fume and health effect of Air Pistol and Air Rifle in Subang National Shooting Range.

Variable 3: Ventilation System

H1: There is relationship between the availability of proper ventilation system and health effect of Air Pistol and Air Rifle shooters in Subang National Shooting Range.

H2: There is no relationship between the availability of proper ventilation system and health effect of Air Pistol and Air Rifle shooters in Subang National Shooting Range.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The potential hazards of lead exposure are a growing concern among the ISSF Air Pistol and Air Rifle shooters. Research shows that lead exposure and lead poisoning has cause adverse health issues namely it may impair verbal memory (Sanna Asa Makaitaipale et al., 2009), cause skin contamination (Mark Boeniger & Susan Puskas, 2008), and effect the male reproductive (Department of Safety and health Malaysia,2002). Mark Boeniger & Susan Puskas (2008) in their research has identified firearms and ammunition as the source of lead exposure to the shooters. Additionally, Krishnan (1977) commented that the handling firearms ammunitions would possibly contaminates the hand with highly variable concentration of lead. In shooting activities, the shooters may exposed to potential lead hazards during the course of firing, weapon cleaning, house keeping and lead reclamation operations (Pinellas County Air Quality, USA - Shooting Guide).

In this chapter, the researcher has explored some literatures that are relevant to the study and presents the review of the relevant researches on the lead exposure and the possible causes of lead exposure to Air Pistol and Air Rifle shooters. The risk of failing to observed and mitigate the cause of lead exposure may lead adverse health issue to the Air Pistol and Air Rifle shooters.

2.2 Definition of Lead

Lead is a toxic substance which could negatively affect human health. The American National Institute of Occupational Safety and Health (NIOSH, 2002) defines lead as a toxic metal that is used in burning fossil fuels and it is classified as a highly toxic substance. According to Pinellas Air Quality, USA lead is defines as a metal that is commonly used in bullets, battery, fishing and diving weights, older metal toys, ceramic grazes and as an additive to gasoline. In Malaysia context, in one of the regulatory provision has defined lead metallic lead, all inorganic lead compounds, and organic lead soap, but excluded all other organic lead compounds (Factories and Machineries (Lead) Regulations 1984).

Lead is classified as a toxicology agent (NIOSH, 2005) and prolong exposure to such substance would be very hazardous to human body (Mark Boeniger & Susan Puskas (2008). Lead could be accumulative in human body over long period of time and could contribute to health risks with small and frequent exposure of such element. This is further supported by David L Goetsch (2011), which concluded that continuos exposure to lead substance would have negative effect on the individual health. Malaysian Occupational Safety and Health (Use and Standards of Exposure of Chemicals Hazardous to Health) Regulation 2000 on the other hand, has regulated certain permissible exposure limit (PEL) with regards to lead as a way mitigate the prolong exposure to the hazardous substance.

Previous researchers clearly show that continuos exposure to lead substance could negatively affect the individual health status. Lead is accumulative in nature and

would take some times before its can be detected. Many studies conducted to determine the potential effect lead can cause to human body. According to David E Jacobs (1996) lead may affect different part human organs and systems and surprisingly lead can be find everywhere in the environment. Michael J Kosnett (2010) in his research on the effect of low dose lead effect on adult and children has argued that the exposure to low dose lead may affect different organs and system relative to age and sexes. Particularly lead may affect the brain development of a children and may contribute to hypertension, decrement in renal function to adult. In addition to that, pregnant women may susceptible to infertility, abortion, weak foetus and premature deliver (NIOSH, 2005).

2.3 Route of Lead Exposure

There are several ways that enables toxic substances to enter into human body. According to David L Goetsch (2011), there are four type of entry of toxic agent into the human body namely through ingestion, injection, skin absorption and inhalation. Ronald G Treble and Thomas S Thompson (2002) asserted in his case that the effect of lead upon human is similar regardless of the route by which it enters the body. However, most of the human exposure to lead occurs through ingestion and inhalation. Ingestion of contaminated food and drinks or use of lead contaminated hands to take food or drink is among other ways lead can be ingested into human body. This statement further supported by Mark Boeeniger & Susan Puskas (2008) who has identified that hand contamination is one the route the toxics substances would enter into human body. His research findings asserted that such hand to mouth process would enable the toxic based material to digest into human body.

Inhalation on the other hand represent second major pathway of lead exposure. Inhaling of lead dust, lead fume and others lead based material could be hazardous to human body and such substance could be accumulated within human body. Breathing inhaling lead in dust, mist or fumes is one of the route lead could enter into human body (NIOSH Update, 2012).

The inhalation period that the people are exposed to is among the factors that determine the possible effect to health risks. Long term exposure in small dose of lead agent would expose to the users to the chronic effect. According to Michael J Kosnett (2010) in his research of small dose lead exposure to adult and children revealed that the continuos and prolong exposure resulted in several of health effect namely hypertension, decrement in renal function and subtle decline in cognitive function. Thus, precaution measures need to be taken to prevent lead agent from entering into our body through breathing or inhalation. Furthermore, Anthony M Gregory (1990) in his research further defined the route of lead exposure on shooting range are mainly through three routes namely breathing in the lead contaminated air, ingesting and by absorption through skin.

2.4 Lead Exposure to Shooters

Shooting activities are among the activities that have direct contact with lead substance through the use of ammunition made from lead substances (Safety & Health Assessment & Research for Prevention, 2000). According to the United State, Wildlife Society (2009), lead was used to manufacture the projectiles because

of its weight, effective and less expensive to produce. The primary source of the lead exposure among the shooters on indoor range is contributed from the pellets; ammunitions used in the shooting activities. Pellet was designed from lead substance and most proponents to the airgun shooting activities claims that it is not contribute harm to the users. Lead based pellet is can potentially bring intoxicant to the human body by the absorption route particularly through ingestion and inhalation. In the shooting activities shooters need to pick up and load the pellet into the airguns breech before it can fire to the dedicated target. Through the process, the shooter have the direct contact and expose to the hazards intoxicology if he not properly wash his hands and at same time using his hands to handle the food or drinks in the cafeteria after the activities.

The lead fume or pellet dust could be potentially inhale by the shooters during the firing activities. Once shooter, pull the trigger, the firing process would provide the dust fume which potentially be inhale by the shooter. Most of the researches conducted were focussed on the effect of the fume and lead particle inhale by the shooter during the firing processes. In the mean time, when shooters fire the air gun, the pellet flies towards the target and penetrate it. After passing through the target, the pallet is captured by a pellet trap or backstop. Such residue, thus provide health effect to the shooters if it is not properly handle and clean. In addition, the activities of discharging, handling and cleaning the firearms would also expose the shooter the lead (European American Armoury).

There is negative relationship between the exposures to lead with the shooters health status. There researchers had conducted various study to determine the possible effect lead could bring to human being. Study conducted by Sanna Asa-Makitaipale, Mervi Jehkonen, Jukka Uitti and Juhani Vilkki (2009) showed that there is positive relationship between the between the use lead substance in shooting activities to adverse effect on memory functions.

Sport shooting activities comprises of many events or categories. Air Pistol and Air Rifle events are referred as the air gun shooting event and they are the basic and fundamental event for shooting categories. Air gun shooting comprised all the shooting activities that use air compressed air or CO2 gas as the pressure to burst the pellet or projectiles in the course of fire. The firing activities are conducted in the indoor shooting which is equipped with the air conditioning which would provide conducive training area for the shooters. Both of the shooting events are designed and suitable to both male and female shooters. Picture 2.4 below shows Air Pistol athlete conducting her shooting training in the indoor shooting range.

Figure 2.4
Air Pistol Shooting

2.5 Process Flow in Shooting Activities

Sport shooting is considered dangerous sport to certain people because of such activities require handling of weapon such as a pistol or rifle. Thus strict rules and procedures need to be adhere by all the shooters to avoid any violation of safety issue in the range. It is the responsibility of every shooter to abide with the established procedures to ensure safe handling and practise of the weapon.

In shooting activities, shooter needs to load the pellet into the airgun chamber, before it can be fire to a designated paper target. In doing so, shooter need to pick the pellet using bare hand and load it to the airguns. The shooters would pick the lead pellets and put into the breech end of their rifle or pistol barrels and are fire towards the target with the support of the compressed air or CO2 gas (USA Shooting and Civilian Marksmanship Program). In the shooting processes, the shooting mechanism would be in operative and push or fire the pellet to the target.

In the air rifle and air pistol shooting, the lead based projectiles or better known as air pellet among the air gun shooting enthusiasts to be use as bullet or ammunition in the firing activities. The pellets used in the air shooting activities are designed from lead and this statement further supported by The Guide of Lead Management for Air Gun Shooting by USA Shooting and Civilian Marksmanship Program (2009) whom identified lead as the basic material to produce the air pellet. Robert D Beeman (2005) in his findings has identified airguns projectiles to include the lead air pellets which were produce from cutting special lead wire and moulded into the shape through automatic machine. Since the core material to produce the pellet is from the

lead base substance, thus the possibility of its effect to individual shooter should not treat lightly. However, scholars in the Western countries vary in their opinion regarding the possible health issues associated with the use of lead pellet in the airguns shooting activities.

The physical characteristic of air pellet that it is 4.5 in diameter or 0.177 calibres and weight 0.50-0.53 grams. It shaped like badminton shuttle cock to provide aerodynamic stability and accuracy. The following picture depicted the air pellet used by the airguns shooters.

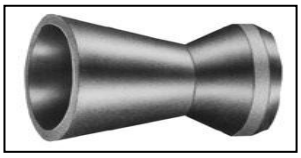

Figure 2.5
Air Pellet

2.6 Conceptual Framework

The researcher framework basically wants to show the relationship between all the contributing factors that would have positive impact to the shooters exposure to lead in the training activities and during the competition. Figure 2.6 illustrated the relationship between all the independent variables (direct handling of lead based pellet, inhalation of lead dust or lead fumes and the availability and proper functioning of ventilation system in the indoor shooting range) and the dependent variable (shooters health).

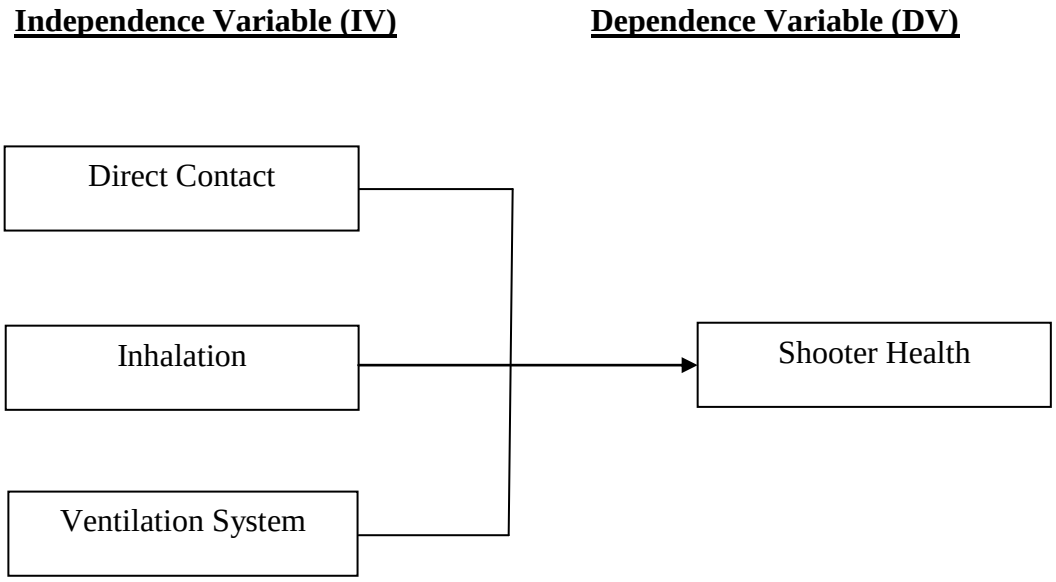

Figure 2.6
Conceptual Framework

2.6.1 Direct contact/Handling

There are a lot of products in market that were produced from lead ranging from paint, soldering, lead acid battery, ceramics and many more worth to mentioned. Various studies were conducted to determine the health effect associated with the use of such substances to the population. The previous research by Anne Sleeuwenhoek and Martie Van Tongoren (2006) in their lead contact test among the 6 volunteers had indicated that as the number of contact with lead surface increased, the number of lead transferred to the hand of volunteers also increased. The result shown that though the dermal exposure were minimal among the volunteers but there is considered important since it can contribute to ingestion exposure as a result of skin to mouth transfer of lead. This research finding is further supported by Suherni (2011) in her research to determine the lead poisoning in Indonesia had identified

that handling of lead products such children playing with the toys and then put in their hand into mouth could potentially exposed to lead poisoning. On the other hand, workplace lead hazard associated with direct contact and use of lead could also be transferred to others especially to their family members (Holly Brown William (2009). For example lead taken home from on work clothes or shoes can expose other family member's especially children and eventually can expose them to lead poisoning and contamination.

Shooting activities in the shooting range in one of the well known sport activities that used lead as part of their activities. It is estimated that 5% of the global lead were use to produce ammunition in the ammunition industry (Chang Kah Haw et al., 2010). Shooters may expose to lead either by touching the lead based ammunition or touching the lead dust or particles that settles on the surface. Study by Mark Boeniger & Susan Puskas (2010) had affirmed that the use of firearms is a primary source of lead exposure among the handgun shooters.

The airguns shooting activities requires the shooters to handle the pellet or projectile in preparation before they fire the airguns to the target. The pellet normally produced from lead as it the ideal substance to produce such projectile due its characteristic and low in cost (USA Shooting & Civilian Marksmanship Program, 2009). As such they need to pick up the pellets and load it to the breech of the gun barrels. Such process has provided them with access or exposure to the lead which may effect to their health. Safety and Health Assessment & Research for Prevention, Department of Labour Industry, USA has identified ingestion through eating with the

contaminated food is one of the source contributed to lead poisoning among the shooters. Such contamination occurs, when shooters does not clean up their hand after handling the pellets during the shooting activities. Shooters who eat and drink without washing the hand after shooting activities may expose to lead contamination or poisoning through the food and drink the ingested into their body.

Another source of exposures is during the process of cleaning up the shooting equipment. It is the responsibility of every shooter to clean up their equipment after every shooting session to ensure the cleanliness of the equipment. Such handling would contaminate their hands with the dust or residue of the lead pellet from the equipment mechanism. Research show that lead exposure would happen during firing and weapon cleaning (Pinelas County Air Quality, USA).

2.6.2 Inhalation

A recent study performed by Lori A Verbrugge et al. (2009) found out that the exposure of lead through inhalation can occur in variety of way namely through lead melting processes, lead dust or particles, contaminated soil or through occupational exposure in manufacturing and mining. Inhalations of lead fume or dust are the primary route that lead enters into human body and lead is commonly absorbed into the body by inhalation. Inhalation is considered then major route of entry for hazardous chemical and provide rapidity of absorption of such material into human body. This statement further supported by Lorenzino Unio (2005) whom asserted

that inhalation of lead is the most dangerous way by which it can be get into the lungs of the people. David L Goetsch (2011) in his findings pointed that the amounts of chemical substance inhale depend on three criteria namely the concentration of substance, durations of exposure and breathing volume. When people breathe, the fume or dust enters into their lungs and upper respiratory and absorb it. Researchers has identified that the primary exposure of lead among shooter would happen when the shooter inhale the fume or the particle or dust suspended into the air from the firing processes (Sanna Asa-Makitaipale et al., 2009). Lilia A Chen and Scott E Brueck (2011) in their research with firing range instructors in California asserted that lead exposure to the instructors occurred through inhalation of dust and fume. Inhalation are the quickest way that the toxic substance particularly lead fume or dust count enter into human body, absorbed into the lung, bloodstream and eventually to the brain (David L Goetsch, 2011).

2.6.3 Ventilation System

Ventilation system refers to the medium which enable circulation of fresh air in a confined area. Ventilation system is required to provide fresh air to the personnel within such specified area and at the same time create air movement within that area. It enables the control of air pollution and dilute air contamination. Thus, good ventilation system is essential to control and exhausting the contaminated air in the workplace. Anuar Ahmad & Zularisam Abd Wahid (2011) refers ventilation as a process by which fresh air is introduced and ventilated air is removed from occupied space. Proper ventilation system is important as mechanism to dilute and control

contamination at workplace (NIOSH, 2005). Bryan L Craig, Dean R Liquist, D Jeff Burton & George L White (2011) argued their study that improper functioning and poorly designed indoor shooting range are among the factors that contribute to high concentration of airborne lead in the range which expose the potential health risk to the shooters.

There are two type ventilation system; namely general ventilation system and local exhaust ventilation system. General ventilation or dilution ventilation is mean of supplying and exhausting a large volume of air of the area through natural or mechanical method. On the other hand, local exhaust ventilation provides a positive means of removing airborne contaminants from the working environment by capturing them at their source (Anuar Ahmad & Zularisam, 2011). On the other hands, failing to provide good ventilation system in the workplace may lead to various health effects such as irritability, impair concentration and performance, fatigue, headache, legionnaire's disease and humidifier fever.

As all the airguns shooting activities is conducted in indoor shooting, thus good ventilation system is essential as an engineering control to reduce the potential lead exposure to the shooter. The indoor range was designed to cater for the indoor activities and equipped with the air conditioning system. Study by Sarah E Valway at el (1989) showed that the indoor shooting activities has contributed to the elevated blood lead level and has negative impact to the shooter health effect. An effective ventilation system can greatly reduce airborne lead exposures at the firing line (Pinelas County Air Quality, USA). A study by CDC (2005) during the period of

2002 until 2004 among 66 shooters in 5 different indoor shooting ranges in Alaska has concluded that among the factors that contributed to the elevated blood lead level among the shooters in the 4 of the 5 ranges under study were resulted from the improper design, operation and maintenance of the ranges.

The potential risk associated with poor ventilation and lead exposure to shooters in the indoor shooting is further evaluated by Jessica G Ramsey and R Todd Niemeyer (2011). According to their study it is indicated that that shooting instructors and shooters in the indoor shooting range in California, USA were exposed to lead above the permissible level authorised and the improper functioning of old ventilation system in the range contributed to the results.

Physical observation from the design and facilities at the 10 meter airguns indoor range at Subang National Shooting Range, revealed that the building were only equipped will general ventilation for the building and no special ventilation system to reduce for lead exposure to the users. Air movement should carry the fume down range away from the shooter's face. General building ventilation is not enough to move the lead containing smoke away from the firing line.

2.6.4 Shooters Health Status

According to the constitution of World Health Organization (2003) the term health is defined as the state of complete physical, mental and social well being and it is not just merely the absence of disease or infirmity. There are many studies conducted by previous researchers had shown that the exposure to lead substance contributed negatively to human health. A study by Mazrura Shanani and Noor Hashim Ismail

(2005) among the 141 Malaysian battery manufacturing factories workers explains that there strong relationship between the lead exposure among the workers and the risk of having adverse health particularly weakness of the lower limbs and loss of appetite among the exposed workers. Health Research for Action (2009) further identified that exposure to lead can bring serious effect to the health and such exposure would lead to hypertension, reproductive problems, decreased in kidney and brain function.

2.7 Summary

There are many studies conducted by international researchers in their effort to determine the relationship between the physical contacts with the source of lead, inhalation of the dust or fume during the shooting process and the available ventilation system to mitigate the polluted air and their associated health issue to the shooters. Since, there is no evidence to suggest that such study had been conducted in Malaysia, thus the researcher would want to examine and the contributing variables as mentioned in the conceptual framework.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This research is design to study the potential exposure risk to lead which would have impact on the shooters health's status in particular to the sporting athlete who were train and compete in airguns shooting i.e. Air Pistol and Air Rifle pistol in the Subang National Shooting Range, Subang Selangor. This chapter covers the methodological aspect of the researches which include the detail deliberation on the research design, population and sample, data collection, data analysis and the finding based on current limitation of the research. This chapter would provide clear explanation on the steps taken in this research.

3.2 Research Design

Researcher uses the questionnaire type of approach to acquire the relevant data for the study. The questionnaire approach was use in this study because such method is an efficient data collection mechanism as pointed out by Sekaran (2003) in his Research Methods for Business book. The questionnaires were distributed to randomly to Malaysian Air Pistol and Air Rifle shooters, who conducted their routine practise and competition during NSAM President Ally T.H Ong 2013 (14 - 17 March 2013) and Tun Hanif Omar Trophy 2013 (7 - 9 June 2013) at the Subang

National Shooting Range. The researcher was studying the health impact of the usage of lead pellet to the Air Pistol and Air Rifle shooter health.

3.3 Population and Sampling

The total population of Air Pistol and Air Rifle shooters in Subang National Shooting Range varies since the occupancy of the range is dependant the regularity of the competition organised by the National Shooting Association of Malaysia (NSAM). However, based on the information derived from the NSAM's Executive Secretary, Mr Subramaniam; it is estimated that a total of 200 shooters were registered for in the Air Pistol and Air Rifle shooting events in every shooting competition. The population of Air Pistol and Air Rifle shooters in Malaysia are quite small in number since shooting sport is perceived by some as expensive sport activities to venture in. In contrast to other sports, ISSF sport shooting activities are open to the public irregardless of age limitation. Most of the shooters come from various States Shooting Association, Malaysian Armed Forces Shooting Association, Royal Police Shooting Association and National Shooters from National Sport Council (NSC). Among the participatory bodies to the competition are namely Pulau Pinang Shooting Association, Perak Shooting Association, Selangor Shooting Association, Melaka Shooting Association, Negeri Sembilan Shooting Association, Johor Shooting Association, Sabah Shooting Association, Malaysian Armed Forces Shooting Association, Royal Police Shooting Association national shooting athlete from National Sport Council (NSC).

Sekaran (2003) defined sample as the subgroup or subset of the population. Thus, by studying the sample, researcher can make generalization about the population interest. The total population in this study is about 200 registered Air Pistol and Air Rifle to the NSAM competition record. However, the total number of the population is based on the active shooters to the range. The simple random sampling is use throughout the study, where 80 questionnaires were distributed among the randomly selected respondents.

3.4 Measurement

There are two measurement tools were used in the research in order to measure the impact of pellet (through the direct contact or handling of lead based pellet, inhalation of lead dust or lead particles release during the shooting activities and the availability and proper functioning of ventilation system in the indoor shooting range) and the level of shooter health. The measurement tools used in this research were adopted from the instrument developed by Hayes et al (1998). The purpose of the research to determine the impact of lead pellet to Air Pistol and Air Rifle to the shooters health. In this case, the researcher want to identify that there are three factors which is the direct contact or handling the lead pellet, the inhalation of lead dust or lead particles during the firing processes and the availability and proper functioning of ventilation system have direct impact to the shooters health.

3.4.1 The Impact of Lead Pellet to Shooters Health

The impact of lead based pellet (Direct contact or handling, inhalation and ventilation system) were measured through 14 items questions that were adopted by the instrument developed by Hayes et al (1998). There were 5 items for Section A, to determine the effect direct handling of lead pellet, 5 items for Section B, to determine the effect of inhalation of lead dust and lead particles and 4 items in Section C, to determine the effect of availability and proper functioning of ventilation system. A five-point Likert scale were used for each item ranging from 1 to 5 for each item whereby 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree

3.4.2 The Shooters Health Effect

The measurement used to determine the shooters health status was adopted from Hayes et al (1998). There were 3 items in this section and such measures were adopted based on the 5-point Likert scale. Respondents were required to indicates their health status after using the lead based pellet during the Air Pistol and Air Rifle shooting activities (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree).

Table 3.4.1 and Table 3.4.2 show the summary of survey instrument in the questionnaires and method measured in the questionnaires based on 5-point Likert scale adopted from Hayes et al. respectively.

Table 3.4.1
Summary of Survey Instrument in the Questionnaires

Section	Description	Variable	No of Question
A	Demographic Profile	-	7
B	Physical Handling	Independent	5
C	Inhalation	Independent	5
D	Ventilation System	Independent	4
E	Shooter Health Status	Dependant	3

Table 3.4.2
Method Measured the Questionnaires Using 5 Point Likert Scales

Scale	Detail Answer in Independent Variable	Detail Answer in Dependant Variable
1	Strongly Disagree	Strongly Disagree
2	Disagree	Disagree
3	Neutral	Neutral
4	Agree	Agree
5	Strongly Agree	Strongly Agree

3.5 Questionnaire Design

There were 20 research questionnaires developed to acquire the essential information regarding the study from the respondents. The questionnaire has been divided into four sections in order to acquire the relevant information that supported this study. The sections development are namely section A – Respondent Demographic Profile, Section B – Physical Handling of Lead Based Pellet, Section C – Potential Risk of Inhalation of Lead Dust, Section D – Respondents View on the Indoor Range

Ventilation System and Section E – The Impact of the Usage of Lead Pellet to Shooters.

3.5.1 Section A - Demographic Profile Question

The questions from this section resolved to the information regarding respondent's gender, age, race, marital status, education level, discipline of ISSF shooting and years of involvement in shooting activities. There were a total of 7 questions were developed to acquire the respondents demographics profile information. The respondents need to respond to the questions by circle the relevant answer applicable to them.

3.5.2 Section B - Physical Handling of Lead Based Pellet

This section comprises five questions regarding the view on the handling of lead based air pellet during the course of firing activities on the indoor shooting range particularly in this scenario in the Subang National Shooting Range, Subang, Selangor. In this section, respondents were required to provide answer to the question based on the Likert Scale ranging from 1 - Strongly Disagree, 2 - Disagree, 3 - Neutral, 4 - Agree and 5 - Strongly Agree.

3.5.3 Section C - Potential Risk of Inhalation of Lead Dust

There are five questions in this section and the questions were developed to seek the respondent's feedback on the potential risk of inhaling the lead dust or residue

during their shooting activities in the range. The respondents were required to give feedback basing on the Likert Scale 1 to 5. Each question would require one answer to be given by the respondents.

3.5.4 Section D – Respondents View on the Indoor Range Ventilation System

This section seeks to analyse the respondent's feedback on the use of proper ventilation system as a medium to mitigate and exhausting the lead contaminated air in the indoor shooting range. The respondents would answer the question by selecting one best answer that suit them using the Likert Scale; 1 to 5. There four questions developed in this section to determine the respondents view on the indoor shooting range.

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3.5.5 Section E – The Impact of the Usage of Lead Pellet to Shooters Health

In this last section, researcher requires the respondent's feedback whether the shooting activities they were involved in have significant effect to their health.

3.6 Pilot Testing

Pilot testing were conducted among the randomly selected respondents during one of the national shooting circuits championship on Mac 2013. 40 respondents were selected among Air Pistol and Air Rifle athletes to test the reliability and clarity of the question developed. According to Sekaran (2003) reliability refers to a measure that indicates the extent to which it is without bias and ensures consistent

measurement across time and across the various item in the instrument. The table 3.5 below shows the Cronbach Alpha values for the variables used in the study.

Table 3.6
List of Cronbach Alpha for All Variables - Test Pilot

ITEM	**TYPES OF VARIABLE**	**CRONBACH ALPHA**	**ITEM DELETED**
Physical Contact/Handling	Independent	0.643	Nil
Inhalation	Independent	0.657	Nil
Ventilation System	Independent	0.802	Nil
Shooter Health	Dependant	0.981	Nil

3.7 Data Collection

Sekaran (2003) identified on of the three main research methods in collecting data is the through administering questionnaires. Thus, in this context, the questionnaires method is being used where the respondents were given blank questionnaires which to be collected from them personally within certain period of times. 80 set of questionnaires were distributed to the respondents during the NSAM President Ally T.H Ong Shooting Trophy 2013 (14 -– 17 Mac 2013) and Hanif Omar Shooting Championship 2013 (6 - 9 June 2013). The respondents will be selected randomly from athletes of various Shooting Association namely States Shooting Association, Malaysian Armed Force Shooting Association and Royal Malaysian Police Shooting Association. The data collection processes would be conducted during the above

mentioned shooting championship period. However out of 80 questionnaires distributed only 47 or 59% were answered and returned back for analysis.

3.8 Analysis Techniques

Quantitative analysis will be used throughout the study to examine the relationship between the shooter's physical contact of lead based pellet, inhalation and the ventilation system to the individual health effect. The bivariate correlation analysis, mean, standard deviation and intercorelation between the variables were study to determine their relationship between one another. The whole analyses were conducted using the Statistical Package for Social Science (SPSS) version 17.0.

3.9 Conclusion

This chapter has discussed deliberately the research design, population and sampling, data collection and data analysis used in this study. The study will be using the premeditated questionnaires developed and show the relationship or impact that the independent variables i.e. the physical contact, inhalation and the ventilation system have on the shooter health status.

CHAPTER 4

RESULT AND ANALYSIS

4.1 Introduction

This chapter shall provide the findings analysis of the study conducted among the Air Pistol and Air Rifle sport shooters who practised on indoor firing range at Subang National Shooting Range. All the respondents were required to provide answer to the relevant question regarding demographic profile namely gender, age, race, marital status, education level, ISSF shooting discipline, years of involvement in ISSF sport shooting and the impact of the independent variable (IV); physical contact with lead pellet, inhalation of lead fume and lead dust and the ventilation system available on indoor shooting to their health status. The data collected from the respondents were analyse using the Statistical Package for Social Science (SPSS) version 17.0. The findings are presented through the following analysis namely;

4.2 Data Processing

Raw data regarding the subject under study were collated from the respondent's feedback for analysis. The respondent's feedback were analyse using the Statistical Package for Social Science (SPSS) version 17.0 to produce the descriptive and inferential statistical results. The raw data received from the respondents answer to the questionnaire were cleaned and screened before it was conducting analysis and hypothesis testing.

4.3 Response Rate

In this study the respondents were chosen from the ISSF sport shooters that specialised in Air Pistol and Air Rifle sport shooters from various local shooting associations who regularly trained and competed in Subang National Shooting Range. A total of 80 questionnaires were distributed to the target group, however, 47 or 59% of the questionnaires distributed, were returned back for analysis.

Table 4.3
Response Rate

ITEMS	TOTAL	%
Total Questionnaires Distributed	80 Questionnaires	100%
Total Questionnaires Answered and Returned back	47Questionaire	59%

4.4 Distribution Frequency Analysis

Descriptive measure will test for measures such as respondent's gender, age, race, marital status, education level, discipline of ISSF shooting and years of involvement in ISSF shooting correlated with impact of lead exposure and lead poisoning to the respondents.

4.4.1 Respondent Demographic Profile

Table 4.4.1 shows the detail demographic profile of the respondents which derived from the output of the SPSS version 17.0.

The respondents for the study were selected from airgun sport shooters that specialise in the Air Pistol and Air Rifle shooting in Subang National Shooting Range. The respondents are mixture of the shooters from various States Shooting Association, Malaysian Armed Forces Shooting Association and Royal Malaysian Police Shooting Association who conducted their shooting activities in the Subang National Shooting Range, Selangor. The following figure depicted the demographic profile of the respondents which encompasses the respondent's gender, age, race, marital status, education level, discipline of ISSF shooting and years of involvement in ISSF shooting.

Table 4.4.1
Summary of Demographic Profile of the Respondents

TYPE	**ITEMS**	**FREQUENCY (N)**	**PERCENTAGE (%)**
Gender	Male	24	51.1
	Female	23	48.9
Age	15 - 19 years	25	53.2
	20 - 30 years	4	8.5
	31 - 40 years	11	23.4
	41 - 50 years	7	14.9
Race	Malay	38	80.9
	Chinese	4	8.5
	Others	5	10.6
Marital Status	Married	17	36.2
	Single	30	63.8
Education Level	SPM	25	53.2
	Diploma	4	8.5
	Ijazah	4	8.5
	Others	14	29.8

Shooting Discipline	Air Pistol Air Rifle	24 23	51.1 48.9
Years of Involvement in Shooting	1 - 5 years 5 - 10 years 11 - 15 years 16 - 20 years 20 years and above Total	27 4 10 4 2 47	57.4 8.5 21.3 8.5 4.3 100.0

4.4.1.1 Analysis on Respondent's Gender

Majority of the respondents were male which constitute 51.1% of the total respondents while female there were 48.9 %. The percentage shows that the majority of the shooters are male as a result that male population are more interested in the extreme and tough activities. Table 4.4.1.1 and Figure 4.4.1.1 summarizes the composition of gender between male and female shooters.

Table 4.4.1.1
Gender of Respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	24	51.1	51.1	51.1
	Female	23	48.9	48.9	100.0
	Total	47	100.0	100.0	

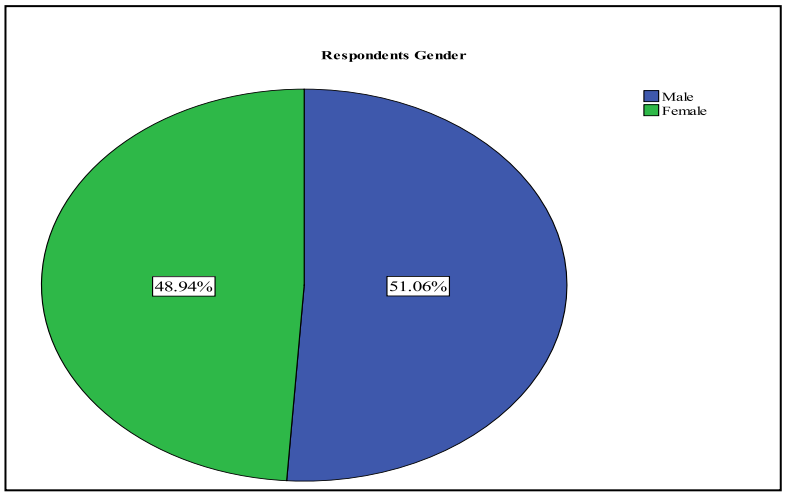

Figure 4.4.1.1
Gender of Respondents

4.4.1.2 Analysis on Age

The mode of respondent's age is from 15 - 19 years old with a total of 25 respondents which constituted 53.2% of the total respondents. The second highest age group 31 - 40 years old and it represent 23.4 %. The age 41 - 50 years old contributed to 7 % and only 4 % range between the age of 20 - 30 years old. Table 4.4.1.2 and Figure 4.4.1.2 show the comparison between ranges of age of the respondents. The results that, the majority of Air Pistol and Air Rifle under study were dominated by the people from the age of 15 to 19 years old, because they are part of the Shooting Association initiatives to prepare and educate young people to venture into shooting activities.

Table 4.4.1.2
Respondent's Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	15 - 19 years	25	53.2	53.2	53.2
	20 - 30 years	4	8.5	8.5	61.7
	31 - 40 years	11	23.4	23.4	85.1
	41 - 50 years	7	14.9	14.9	100.0
	Total	47	100.0	100.0	

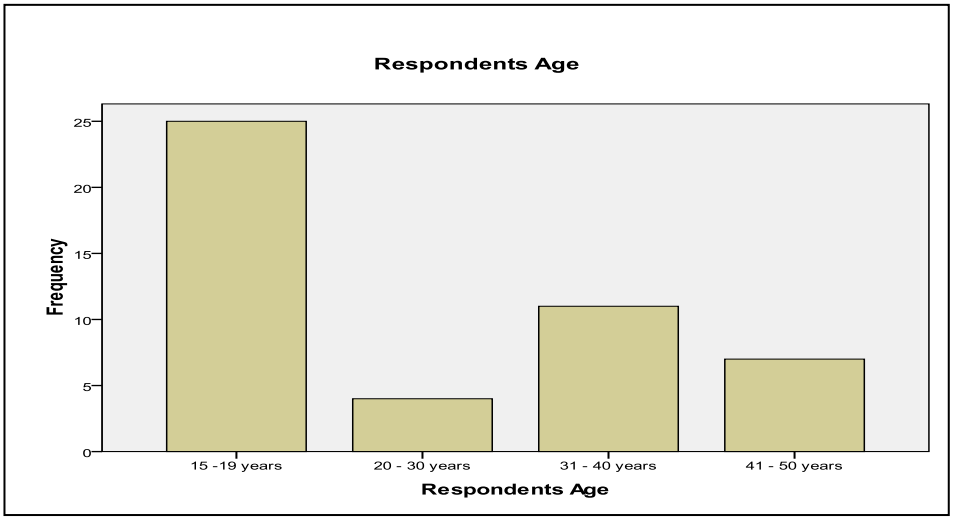

Figure 4.4.1.2
Respondent's Age

4.4.1.3 Analysis on Race

Based on Table 4.4.1.3 and Figure 4.4.1.3 below show the different race group of the respondents. Most of the respondents who involved in air pistol and air rifle shooting are Malays with 80.9 % , 8.5 % are Chinese and other races constituted 10.6 % of the respondents. This shows that the ISSF sport shooting activities are quite familiar among the Malays shooters.

Table 4.4.1.3
Analysis of Races

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Malay	38	80.9	80.9	80.9
	Chinese	4	8.5	8.5	89.4
	Others	5	10.6	10.6	100.0
	Total	47	100.0	100.0	

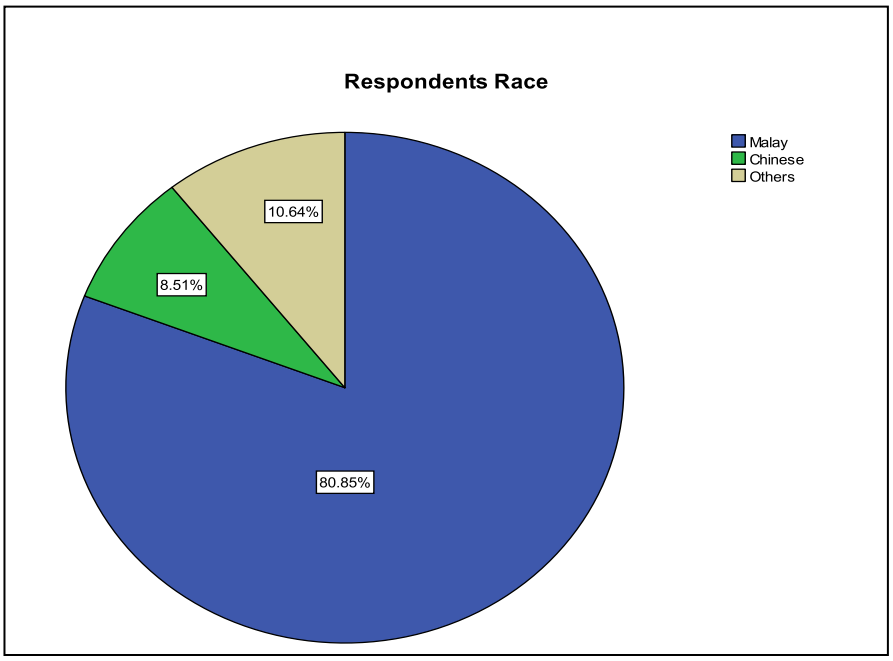

Figure 4.4.1.3
Analysis of Races

4.4.1.4 Analysis on Marital Status

As shown in the Table 4.4.1.4. and Figure 4.4.1.4; most of the respondents are single with 63 % from the respondents followed by married which is 36.2 %. No respondents of ISSF airguns shooting athletes are categorised in the others group.

Table 4.4.1.4
Analysis of Marital Status

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Married	17	36.2	36.2	36.2
	Single	30	63.8	63.8	100.0
	Total	47	100.0	100.0	

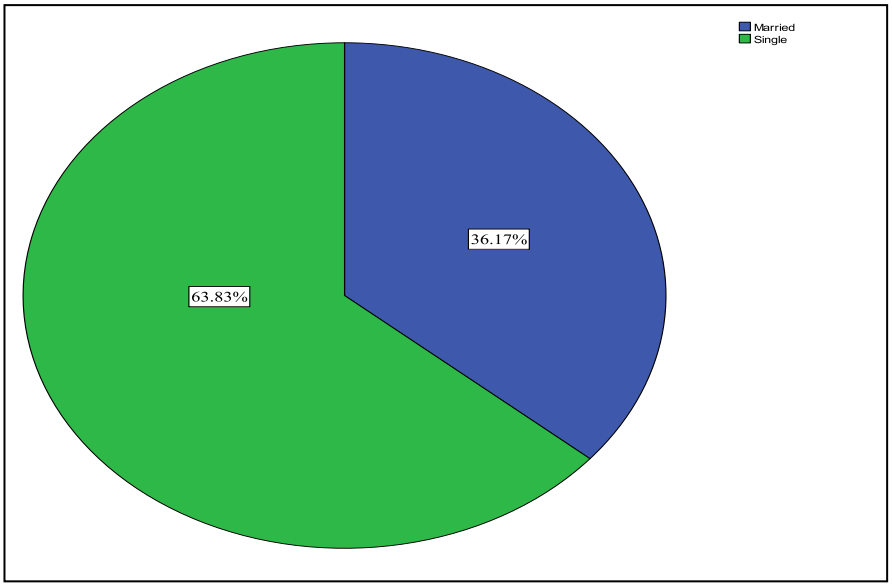

Figure 4.4.1.4
Analysis on Marital Status

4.4.1.5 Analysis on Education Level

The education level of the respondents are divided into 6 levels namely Sijil Pelajaran Malaysia (SPM), Diploma, Bachelor Degree, Master Degree, PhD and others. Majority of the shooters were SPM holders which constitute 53.2%, followed by others qualification such Sijil Penilaian Menengah Rendah (PMR) 29.8% and the diploma and degree holder each represent 8.5 % of the respondents.

Table 4.4.1.5
Analysis on Education Level

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SPM	25	53.2	53.2	53.2
	Diploma	4	8.5	8.5	61.7
	Ijazah	4	8.5	8.5	70.2
	Others	14	29.8	29.8	100.0
	Total	47	100.0	100.0	

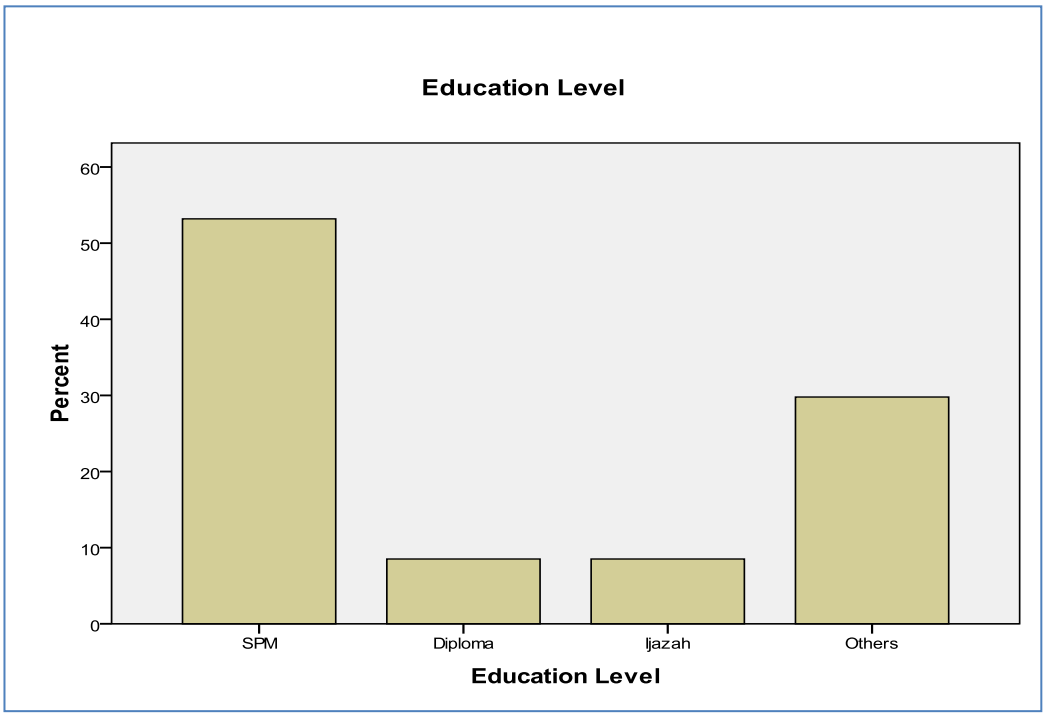

Figure 4.4.1.5
Analysis on Education Level

4.4.1.6 Analysis on Discipline of Shooting

The ISSF sport shooting discipline is divided into 3 namely air pistol discipline, air rifle discipline and shotgun discipline. The focus of this research however is focused mainly to air pistol and air rifle discipline. Based on the analysis, 51.1% of the

respondents were air pistol shooters and 48.9% were air rifle shooters. Table 4.4.1.6 and Figure 4.4.1.6. show the composition of both air pistol and air rifle shooters.

Table 4.4.1.6
Summary of Demographic Profile of the Respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Air Pistol	24	51.1	51.1	51.1
	Air Rifle	23	48.9	48.9	100.0
	Total	47	100.0	100.0	

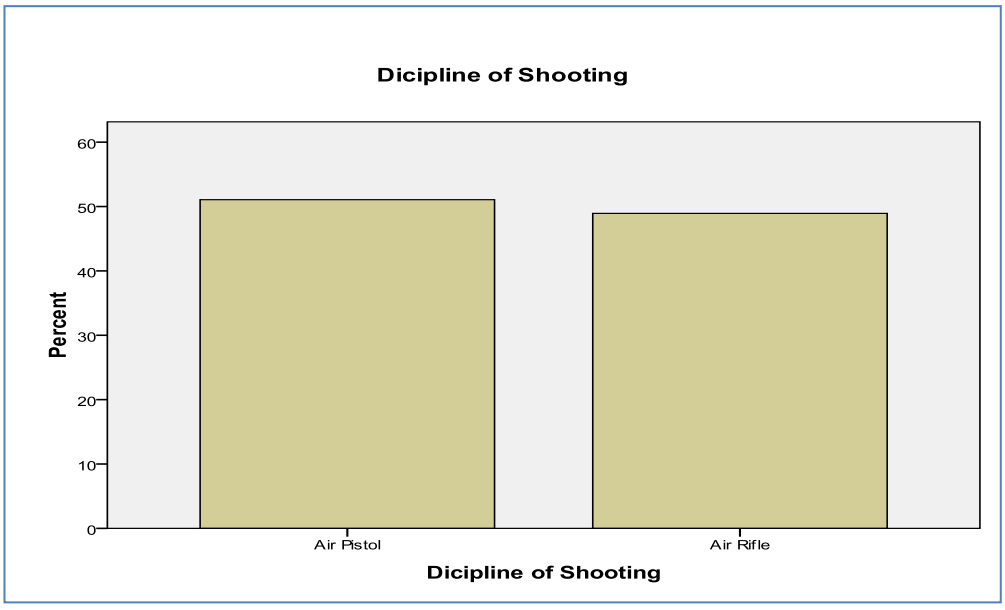

Figure 4.4.1.6
Analysis on Discipline of Shooting

4.4.1.7 Years of Involvement in Shooting

Years of involvement in shooting activities are divided into five division; 1 - 5 years, 5 - 10 years, 11 - 15 years, 16 - 20 years and 20 years and above. The bigger majority of the respondents spend their on shooting activities between 1 - 5 years and this majority represent 56.4 %.

Table 4.4.1.7
Years of Shooting

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 - 5 years	27	57.4	57.4	57.4
	5 - 10 years	4	8.5	8.5	66.0
	11 - 15 years	10	21.3	21.3	87.2
	16 - 20 years	4	8.5	8.5	95.7
	20 years and above	2	4.3	4.3	100.0
	Total	47	100.0	100.0	

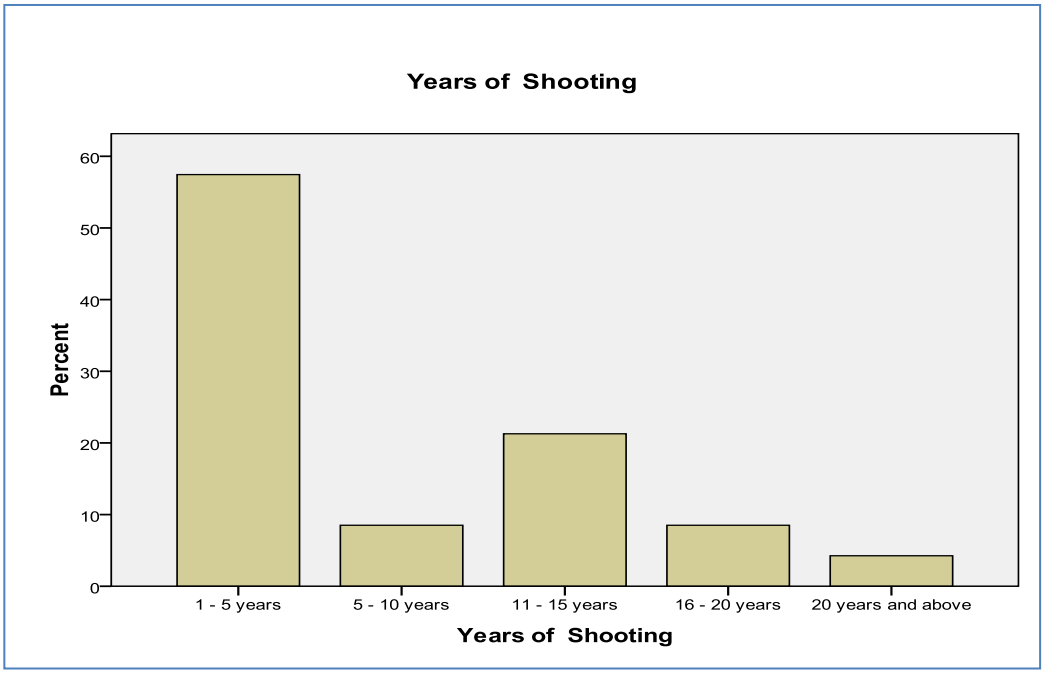

Figure 4.4.1.7
Years of Shooting

4.5 Reliability Analysis

Reliability test was conducted to determine the reliability of the variable using the coefficient of Cronbach Alpha. The Cronbach value is range from 0 to 1. The higher the value the more reliable and consistent the data is.

Table 4.5
Reliability Analysis

Variables	**Cronbach's Alpha (α)**
Physical Contact/Handling	0.663
Inhalation	0.604
Ventilation system	0.775
Shooter Health Status	0.945

Table 4.5 shows the reliability if independent in this study. Respondents were required to provide their preferences to the questions based on Likert scale. It is observed that from the above findings the consistency of all variables is range between 0.663 to 0.945. According to Cronbach (1951) the scale of reliability range from 0 to 1, whereby the higher the score, the more reliable the data is. Therefore in this case all of variable value are more than 0.5 can be used for further analysis.

4.6 Descriptive Statistics

Among the three variables, physical contact/handling had the highest mean score with 4.1574 and the inhalation scored the lowest means with 3.6085. Meanwhile for the standards deviation the shooter health status is scored the highest with 0.98769 and followed by the ventilation system with the score of 0.768. Table 4.6 below shows the descriptive statistic for three variables in this study.

Table 4.6
Mean of Variables

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Direct Contact	47	3.20	4.80	4.1574	.44318
Inhalation	47	2.40	5.00	3.6085	.69901
Ventilation	47	1.75	4.75	3.7553	.76877
Shooter Health Status	47	1.00	4.67	3.7376	.98769
Valid N (list wise)	47				

4.7 Pearson Correlation Analysis

The result of the correlalation of all independent variables which is the physical contact and handling of lead pellets, inhalation of lead dust and fume, and provision of proper ventilation system in the indoor shooting range with dependant variable, the effect to the shooter health status. The relationship with all the above mentioned variables were analyse through the Pearson Correlation Coefficient. As mentioned by Sunanti Yusoff (2011) correlation determine the relationship between variables and the value of coefficient correlation can be determined as the following; 0.00 to 0.2 means the correlation is very weak, 0.21 to 0.40 means correlation is weak, 0.41 to 0.70 means correlation is strong, 0.71 to 0.90 means correlation is very strong, 0.91 to 0.99 means the correlation is very strong and 1.00 is the perfect correlation.

Table 4.7 show the complete result of the Pearson Correlation between all the variables under study (The direct contact of air pellet, inhalation of lead dust of fume, availability and proper functioning of ventilation system in indoor shooting range and the effect to the shooters health). The relationship between the

independent variables and the effect to the shooters health status was analysed using Pearson Coefficient Correlation. Preliminary analysis was performed to determine the no violation of assumption on normality, linearity and homoscedatisity. There were strong and positive relationships between inhalation of lead dust and fume ($r=0.47$, $N=47$, $p< 0.01$) and the availability and proper functioning of ventilation system ($r=0.92$, $N=47$, $p<0.01$). There was a weak and negative relationship between direct contact of air pellet to the shooters health status ($r=-0.25$, $N=47$, $p<0.01$).

Table 4.7
Pearson Correlation Analysis Results

Correlations

		Shooter Health	Direct Contact	Ventilation	Inhalation
Shooter Health	Pearson Correlation	1	-.251	.916**	.461**
	Sig. (2-tailed)		.089	.000	.001
	N	47	47	47	47
Direct Contact	Pearson Correlation	-.251	1	-.258	-.229
	Sig. (2-tailed)	.089		.080	.122
	N	47	47	47	47
Ventilation System	Pearson Correlation	.916**	-.258	1	.659**
	Sig. (2-tailed)	.000	.080		.000
	N	47	47	47	47
Inhalation	Pearson Correlation	.461**	-.229	.659**	1
	Sig. (2-tailed)	.001	.122	.000	
	N	47	47	47	47

**. Correlation is significant at the 0.01 level (2-tailed).

Based on the analysis above, there is strong correlation between the shooter health status with the availability of proper ventilation system in the indoor shooting range and inhalation of the lead fume.

4.8 Regression Analysis

Previous researchers has pointed out that the independent variables is useful in predicting the dependant variable when the level of significance is below p< 0.05. The results in the table 4.8 below show that there is significance relationship between the inhalation of the lead dust or lead particles and the availability of proper ventilation system in the indoor range to the shooter health status. However, it observed that there is insignificance relationship between the physical contacts and handling of the lead pellet to the shooter health status. In other words, the physical contact and handling of lead air pellet does not provide significance effect to the shooter health status.

Table 4.8
Regression Coefficients Analysis Table

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.152	.669		.227	.821
	Direct Contact	-.072	.125	-.032	-.581	.564
	Inhalation	-.362	.101	-.256	-3.565	.001
	Ventilation system	1.382	.093	1.076	14.874	.000

a. Dependent Variable: Shooter Health Status

Table 4.9 outlines the R Square result for the regression analysis. R Square is refers to the statistical measure of how close the data are to the fitted regression line. The R Square value is ranging from 0 and 100%. 0 indicates that that the model explains no of the variability of the response data around its mean. Meanwhile 100% indicates

that the model explains all the response data around it mean. Table 4.9 indicates that the R Square of the independent variable (direct contact, inhalation and ventilation system) of the study is 0.875. In general, the higher the R Square the higher the better the data support the model. In this case, R Square (0.875) indicates that there is strong relationship between variables to support the study.

Table 4.9
Model Summary Analysis Table

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.936[a]	.875	.867	.36049

a. Predictors: (Constant), Ventilation, Direct Contact, Inhalation

4.9 Hypotheses Testing

This section has analysed each of the hypotheses that has been developed in Chapter 2. Based on the analysis conducted, it can be determine that there is positive relationship between the two independent variables; the inhalation of lead dust or lead particle during shooting activities and the ventilation system with the dependant variable; the shooter health status.

The summary of the hypotheses testing is illustrated in the table 4.9 below:

Table 4.10
Hypotheses Testing

HYPOTHESES		OUTCOME
H1	There is a positive and significant relationship between direct contact with lead based pellet and shooter health effect	Rejected
H2	There is a positive and significant relationship between inhaling of lead fumes and dust particles and shooters health effect.	Accepted
H3	.There is a positive and significant relationship between ventilation system and shooter health effect.	Accepted

5.0 Conclusion

Based on the results of the analysis, it is observed that there a positive relationship between the inhalation of lead dust and lead particle and the availability of the ventilation system in the indoor shooting range to the shooter health status. Hence, the Hypotheses 2 (H2) and Hypotheses 3 (H3) is supported and accepted in this research.

CHAPTER 5

DISCUSSION AND RECOMMENDATION

5.1 Introduction

The purpose of the study conducted is to determine the contributing factors that may affect the health of ISSF Air Pistol and Air Rifle sport shooters who practised and competed on indoor shooting range in Subang National Shooting range. Proper awareness on the lead management to the ISSF sport shooting activities is essential to prevent them from exposing to the possible health hazards particularly the lead contamination and poisoning.

5.2 Discussion

The result of the analysis shown that there is positive relationship between the independent variable (IV); inhalation of lead dust or lead particle during the course of shooting on indoor shooting range and the proper ventilation to the shooter health status.

5.2.1 Direct Contact of Lead Pellet with the Shooter Health

Based on the finding it is observed that regression analysis result indicates that the physical or direct contact with the lead pellet is insignificance to the shooter health

effect. The result of this finding however similar to the report study USA Shooting & Civilian Marksmanship Program (2009) which indicates that there is clinical evidence that handling of lead pellet during airgun practises does not contribute to the elevated lead level in the blood of a shooter. However, most researchers are in consensus that ingestion of the lead agent could contribute to potential risk of lead to the individual shooter.

Thus, it is the responsibility of every shooter to take precaution measure during handling the pellets. Hands need to be wash with proper soap after shooting activities in the range as a way to avoid contamination with the food or drink. Cloth need to be change and wash accordingly, to prevent from transferring the lead dust to others especially children.

5.2.2 Inhalation of Lead Dust and Lead Particles with the Shooter Health

The possibility Air Pistol and Air Rifle shooters are exposed to the risks of inhaling the lead dust or lead particle in the shooting range are higher compared to outdoor shooting range. This is evidence from the regression analysis finding which indicated that there is positive relationship between the inhalation of such material to the shooter health. The finding indicates the regression between the two variables show the significant value for the correlation is 0.001 which less that 0.05. Any hypotheses with sig < 0.05 are accepted. Thus, it is true that the inhalation of lead dust can negatively harm shooter's health.

5.2.3 Ventilation System with the Shooter Health

The relationship between the availability of the ventilation system in the indoor shooting range and the shooter potential health effect is measure by correlation test using SPSS package version 17.0. Result shows there is strong relationship between the ventilation system and the shooter health status ($r = .916$, $p < 0.01$)

The findings of this study has similarity with the guideline provided by the Penillas County Air Quality which mentioned that good air ventilation is essential to reduce the exposure of lead at the firing line.

5.3 Limitation

The findings from this study are subject to numerous limitations. Some of the limitations observed during the conduct of the study are as following:

- The research focused on the Air Pistol and Air Rifle shooters who practised on the indoor shooting range. Realising the total population of the sport shooters in Malaysia are small in number the researcher should include other shooting discipline into the study in order to get better results from the study.

- The four months time period to complete the research as well a lack of experience in conducting research and difficulty in getting data within the allocated time from respondents are among few challenges facing the

researcher in finishing the study. The amount of questionnaires answered and returned back for analysis is also given a little bit limitation to the study. The accuracy of the data collected through questionnaire were very much dependant on respondent the sincerity and truthfulness in providing answer to the questionnaire.

- Limited references and study conducted in the field is another limitation to complete the study. Most of the researches conducted in the shooting field with less concentration on the Air Pistol and Air Rifle shooting discipline. In addition to that, there is no evidence that any study has being conducted by local researcher in determining the lead effect to the shooter.

5.3 Implications to the Shooters

There some important consideration that needs to be taken into consideration:

Firstly every shooter must be aware about the lead exposure risks. Since majority of the respondents are between 15 - 19 years olds, they are more susceptible to the harm of lead exposure. The management of shooting range should provide proper awareness program to the new shooters regrading the potential risks associated with the Air Pistol and Air Rifle shooting activities in the indoor range.

Secondly, since the ventilation system is essential in circulate the fresh air and diluted the contaminated air from the indoor shooting range, the management of the shooting range should take the necessary measure to ensure the existing ventilation

system is operative at all times during the firing activities. Schedule maintenance of the ventilation system should be conducted periodically to check and maintain the serviceability of the equipment.

Thirdly, the housekeeping of the shooting range needs to be done accordingly with proper cleaning of the dust particle or residue. Shooting range should be maintained clean at all time to avoid any potential lead hazards available to the shooters.

5.4 Recommendations for Future Researcher

This study has limited scope and time constraint to acquire all the possible lead effect to the Air Pistol and Air Rifle health. Future researcher need to engage in more comprehensive study by using variety of methods to collect the relevant data of the study. More scientific approach should be done in order to gauge the level of lead contamination in indoor shooting. Scientific study to test the content of lead in the indoor shooting is necessary and may be include in the future research.

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