A STUDY ON THE EFFECT OF FIREARMS ON THE HEARING OF MILITARY PERSONNEL

by

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In The Name Of ALLAH

The Most Beneficient

The Most Merciful

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ABBREVIATIONS

dB	=	decibel
DPOAE	=	distortion product otoacoustic emission
Hz	=	hertz
kHz	=	kilohertz
NIHL	=	noise induced hearing loss
OAE	=	otoacoustic emission
OHC	=	outer hair cells
PTA	=	pure tone audiometry
PTS	=	permanent threshold shift
RMAF	=	Royal Malaysian Arm Forces
SLM	=	Sound Level Meter
SNHL	=	sensorineural hearing loss
SPL	=	sound pressure level
TTS	=	temporary threshold shift

DEFINITION OF TERMS

Audiogram	-	Graph of hearing threshold level as a function of frequency (ANSI, 1995)
Audiometry	-	Measurement of the hearing threshold for the various frequencies of sound waves
Audiometer	-	The equipment used to perform audiometry
Decibel (dB)	-	The unit used to express the level of sound. The decibel is a logarithm of a ratio of two quantities, the denominator of which has been specified such that 0 dB approximates the threshold of hearing in the middle frequencies for young adults. The reference quantity in the denominator of the ratio is either a sound pressure of 20 micropascals (μPa) or a sound intensity of 10^{-12} watts/m^2.
Frequency	-	The number of times that a periodic process, such as a sound wave, repeats each second.

Hertz (Hz):	-	A unit of frequency equal to one cycle per seconds.
Noise	-	Undesired sound. By extension, noise is any unwarranted disturbance within a useful frequency band, such as undesired electric waves in a transmission channel or device (ANSI, 1994)
Permanent threshold shift	-	Permanent increase, measured in decibels, in the threshold of audibility for an ear (ANSI, 1995).
Prevalence	-	The number of events (e.g., instances of a given disease or other condition) in a given population at a designated time (Last, 1995).
Sound	-	Auditory sensation evoked by an oscillation in pressure, stress, particle displacement, particle velocity, and so on, in a medium with internal forces (e.g., elastic or viscous) (after ANSI, 1999).
Sound Level Meter	-	The equipment to measure the environment sound
Steady-state noise	-	Ongoing noise, the intensity of which remains at a measurable level without interruptions

over an indefinite or specified period of time

Sensorineural - Pertaining to a sensory nerve of mechanism

Temporary threshold shift - Temporary increase, measured in decibels, in the threshold of audibility for an ear (ANSI, 1995).

ABSTRAK

Tujuan utama kajian ini adalah untuk mempastikan jumlah peratus telinga kurang pendengaran dan penyakit telinga sementara ke atas anggota tentera yang menjalani latihan menembak.

Kajian ini adalah kajian hirisan lintang yang telah di jalankan di Kem16 Melayu, Rejimen Askar Melayu Diraja, Kem Desa Pahlawan , Air Lanas, Kelantan dan Kem 301, Tanah Merah, Kelantan , dari Julai 2007 sehingga Oktober 2007. Populasi kajian di ambil dari anggota tentera yang terlibat dalam latihan membak. Sejarah dan maklumat anggota tentera yang terlibat di rekod dan di simpan. Pemeriksaan telinga, "tympanometry", audiometri dan "otoacoustic emission (DPOAE)" di lakukan kepada semua yang terlibat, keputusan kajian akan di rekod. Kajian dan pemeriksaan di jalankan sebanyak tiga peringkat, iaitu sebelum latihan menembak , kurang 48 jam selepas latihan menembak dan dua minggu selepas latihan menembak. Subjek di anggap mempunyai kekurangan pendengaran jika paras pendengaran melebihi 30 db pada mana-mana frekuensi.

Sejumlah 210 orang anggota tentera terlibat di dalam kajian ini. Kesemuanya adalah lelaki. Taburan umur mereka adalah di antara 21 tahun sehingga 47 tahun. Peratus mereka yang mengalami telinga tengah berair adalah sebanyak 21.1% untuk telinga sebelah kanan, manakala untuk telinga kiri adalah 20%. Kebanyakkan masalah kurang pendengaran bagi kedua-dua belah telinga berlaku pada frekuensi 6 kHz, 50.5% adalah pada telinga kanan dan 67% pada telinga kiri. Peratusan mereka yang mengalami kekurangan pendengaran sementara selepas menembak untuk telinga kanan adalah 26%, sementara sebalah kiri 21.4%. Bagi kekurangan pendengaran kekal selepas menembak, untuk telinga kanan dan kiri , masing–masing adalah 11% dan 8%. Mereka yang menembak dengan menggunakan tangan kanan ,memberi nilai kemaknaan pada "p value<0.05" yang menyebabkan kekurangan tahap pendengaran pada telinga sebelah kiri. Terdapat hubungan yang kuat di antara umur, bilangan

bekerja dalam tahun dan frekuensi latihan menembak yang menyebabkan kekurangan tahap pendengaran dengan nilai "p value < 0.005".

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ABSTRACT

The aim of this study was to establish the prevalence of hearing impairment and transient effect of ear pathology among the army personnel who underwent firearm training without wearing hearing protection.

A prospective cross-sectional study was carried out in RMAF 16 Melayu Infantry unit of Desa Pahlawan camp, Kelantan and from infantry unit of 301 camp, Tanah Merah , Kelantan, from July 2007 till October 2007. The population was taken from an army personnel who involved in firearm training.The subject's particulars and history takings were recorded and compiled. The subject's were examined by using otoscope, tymponometry, portable audiometry and otoacoustic emission (DPOAE) and findings were recorded. Evaluation and examination was performed in three stage , pre shooting , post shooting less than 48 hours and post shooting more than 2 weeks. Hearing threshold above 30 db at any frequencies was considered hearing impairment.

A total number of 210 army personnel were involved in this study. All were males. The age range was from 21 years to 47 years old. The prevalence for post shooting of the right middle ear effusion was 21.1% and for left 20%. Majority of the hearing impairment occured at frequency of 6 kHz for both ears, 50.5% for right ear and 67% at left ear. The prevalence of temporary threshold shift was 26% for right ear and 21.4% for left ear. For permanent threshold shift, the prevalence for right and left ear was 11% and 8.1%. Those who were right handed shooter gave a significant p value < 0.05, caused hearing impairment to the left ear. There was strong relation between age, duration of work and frequency of firearm training causing hearing impairment, with p value < 0.05.

Results from this study indicate that there is an urgent need from the Ministry of Defense to develop appropriate intervention or hearing conservation program in order to prevent army personnel from developing the noise induced hearing loss.

CHAPTER ONE:

INTRODUCTION AND LITERATURE REVIEW

CHAPTER 1

INTRODUCTION

Noise-induced hearing loss is the number one occupational disability. It is generally painless, progressive over time and permanent, however it is preventable. Noise is define as unwanted sound , which is characterize by frequency(pitch), intensity(loudness), nature(steady-state vs. impulse/impact) and duration.(Clark. W. W. 1991).

Initially, exposure to noise causes a loss of sensitivity to high frequency (high pitch) sound, continued exposure results in damage to mid frequency region as well. (Henderson et al 1993). One can experience progressive high frequency hearing loss and not be aware of it until it becomes severe (doesn't affect loudness perception). (Mcfadden. D, 1986)

Noise scientifically defined to be a hazard depending on duration of exposure, intensity (volume) of sound, repeated exposure, individual susceptibility ,Berger EH (2000) , for example exposure to >85dBA for steady-state noise sources and >140dBP for impulse/impact noise sources. Examples for steady-state noise are Rustling Leave(20dB) , Conversation(60dB) , Automobile(70dB) , Alarm Clock(80dB) , Screaming Child (90dB), Helicopter(110dB) and Live Concert(130dB). Examples for impulse noise are M16, blanks w/suppressor (147dB) , Vulcan XM197 20mm (159dB), Shotgun 12 gauge(160dB) , Machine Gun 60 cal(165dB) , Launcher, M20-A 35" Rocket(171dB) , TOW Missile(180dB). Loss of hearing sensitivity due to hazardous noise exposures from either steady state noise or impulse noise does occur even before we can measure the change and it does carry negative consequences. (Alberti. P. w. 1990)

Temporary Threshold Shift (TTS): During short exposure to noise, most people experience a rise in the auditory threshold which normally disappears in 24 hours, but may last as long as a week.(Bohne D.A 1982). Recovery is slow and related to the degree of temporary threshold shift. If the stimulus is strong enough, irreversible changes may occur, although it was originally stated that the maximum temporary threshold shift occurs half an octave above the centre frequency of .the stimulating sound (McFadden, 1986). Most recovery occurs in the first 2 days. (Henderson *et al.* (1992).

Permanent Threshold Shift (PTS) or *Noise Induced Permanent Threshold Shift (NIPTS):* After prolonged exposure to noise, permanent hearing damage may result in the inner ear. This is an irreversible elevation of the auditory threshold produced by noise exposure, associated with permanent pathological changes in the cochlea. noise damage the sterocilia, hair cells body suffer from metabolic exhaustion, swell up and finally lead to death of the cell, may damage the microvascular system, reduced nutrients supply to organ of corti.(Boettcher 1989)

Noise is one of the most common health hazards soldiers and civilians face in the workplace and during training. (Berger et al, 2000). The most dangerous occupational and recreational noise is from firing weapons. Exposure to high-intensity noise may cause hearing loss that can adversely affect combat effectiveness and soldier readiness

1.1 DEFINITION OF HEARING LOSS

The degree of hearing loss is described in decibels (dB), a unit of intensity or loudness. Levels of hearing handicaps are usually described as the degree of hearing loss in decibels.

According to WHO classification, the degree of hearing impairment has been classified accordingly.

Table 1. WHO classification system for degree of hearing loss (Andrew.S,1999)

Degree of Hearing Loss	Decibels (dB)
Normal	< 25
Mild	26-40
Moderate	41-60
Severe	61-80
Profound	>81

1.2 ANATOMY AND PHYSIOLOGYOF THE INNER EAR

1.2.1 ANATOMY

The inner ear consists of the auditory and vestibular labyrinths. The term labyrinth is used to denote an elaborate and careful of connecting pathways in the petrous portion of each temporal bone. The osseous labyrinth is the channel in the bone; the membranous labyrinth is composed of soft tissues fluid filled channels within the osseous labyrinth that contain the end- organ structures of hearing and vestibular systems.

The auditory labyrinth is called the cochlea and is the sensory end organ of hearing. It consists of fluid filled membranous channels within a spiral canal that encircles a bony central core. Here the sound waves, transformed into mechanical energy by