PREVALENCE OF NOISE INDUCED HEARING LOSS AMONG KITCHEN STAFF IN MALAYSIA EAST COAST HOSPITAL

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DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTER OF MEDICINE (OTORHINOLARYNGOLOGY - HEAD AND NECK SURGERY)

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My deepest appreciation also goes to my co-supervisor, Dr Nik Adilah Nik Othman, for her kind patience and great guidance, assistance and consultation from the beginning till the end of this study.

I would also like to forward my greatest thanks to all lecturers, clinic staffs of ORL-HNS department, all audiology staffs, and all dietary department staffs from Hospital Tengku Ampuan Afzan, Hospital Kemaman, Hospital Sultanah Nur Zahirah, Hospital Besut and Hospital Universiti Sains Malaysia for your kind cooperation and friendly support.

Finally, I would like to dedicate my work to my parents, who have devoted their lives to ensure that I get the best of everything. Without them, I would not have reached today's achievement. Thank you again.

DISCLAIMER

I declare that this dissertation records the results of the study performed by me and that it is of my own composition.

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(LO REN HUI)

Date:

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LIST OF ABBREVIATIONS

NIHL – Noise Induced Hearing Loss

TTS – Temporary Threshold Shift

PTS – Permanent Threshold Shift

SME – Small Medium Enterprise

NOISH – National Institute for Occupation Safety and Health

ACOEM – American College of Occupational and Environmental Medicine

HSNZ – Hospital Sultanah Nur Zahirah

HTAA – Hospital Tengku Ampuan Afzan

HUSM – Hospital Universiti Sains Malaysia

EAC – External Auditory Canal

dB – Decibel

kHz – Kilohertz

SD – Standard Deviation

n – Frequency

CI – Confidence Interval

ABSTRAK (BAHASA MALAYSIA)

Pengenalan:

Bunyi bising boleh membahayakan pendengaran. Sejak revolusi industri, pelbagai kilang berskala besar telah diketahui boleh menghasilkan bunyi bising yang berlebihan. Di antara adalah dapur hospital, ia mungkin menghasilkan pencemaran bunyi yang kuat.

Objektif:

Mengkaji prevalen masalah pendengaran akibat bunyi bising dalam kalangan tukang masak dan pekerja lain di hospital di Pantai Timur Malaysia

Kaedah:

Kajian ini merupakan kajian "cross sectional" yang diskriptif mana sumber populasi adalah terdiri daripada kakitangan dapur dari lima Hospital Pantai Timur Malaysia berbanding dengan kakitangan lain dari hospital yang sama. Data dikumpul di klinik pesakit luar lima hospital ini dengan mengisi proforma, pemeriksaan otoscopi dan ujian pendengaran dengan menggunakan "pure tone audiometry" di bilik kalis bunyi sekurang-kurangnya selepas 48 jam bebas daripada pendedahan bunyi.

Keputusan:

Seramai 123 kakitangan dapur hospital dan 122 kakitangan bukan dapur hospital mengambil bahagian dalam kajian ini. Didapati prevalen kurang dengar antara kakitangan dapur hospital (54.3%) berbanding dengan kumpulan lain (27%) adalah ketara. Peturunan "pure tone audiometry" adalah paling banyak pada 6kHz, diikuti oleh 4kHz dan 3kHz. Terdapat juga perbezaan min yang ketara pada jumlah tahun kerja di dapur hospital bagi kumpulan berbeza tahap gangguan pendengaran (ringan, sederhana, teruk).

Kesimpulan:

Kajian ini menunjukkan bahawa bunyi bising dapur di hospital adalah merbahaya bagi kakitangan yang bekerja di dalamnya. Kakitangan dapur akan mengalami gangguan yang lebih teruk berikutan jangka masa yang lebih lama. Kami mengesyorkan semua kakitangan dapur hospital menggunakan peralatan pelindung pendengaran semasa bekerja di dapur.

ABSTRACT (ENGLISH)

Introduction:

Noise can be hazardous as it is known to cause hearing loss. Since the industrial revolution, various factories or large scale set up are known to produce excessive noise. Kitchen especially hospital kitchen is one of it that produce tremendous noise pollution. Long hours of working in hospital kitchen may potentially lead to hearing loss.

Objective:

To study on noise induced hearing loss (NIHL) among hospital kitchen staff compare to other staff in East Coast Malaysia Hospitals.

Methodology:

This was a descriptive cross-sectional study. The source population was from kitchen staffs of 5 Malaysian East Coast Hospitals comparing to other hospital staffs (hospital clerk, clinical based medical attendant) of the same hospitals. The data were collected at these 5 hospitals, outpatient clinics to fill the pro forma, otoscopic examination and hearing test using pure tone audiometry in a soundproof room at least 48 hours after the subjects were free from noise exposure.

Results:

A total of 123 hospital kitchen staffs and 122 other hospital staffs participated in this study. There was a significant correlation of noise induced hearing among the hospital kitchen staffs (54.3%) compared to the other group (27%). The dip on pure tone audiometry was mostly at 6kHz, followed by 4kHz and 3 kHz. There was a significant mean difference of years of service between groups (mild, moderate, severe) of hearing impairment (p=0.010).

Conclusion:

This study showed that hospital kitchen noise is hazardous to its working staffs that working. Kitchen staffs will have a worse hearing loss following longer term of working years. We recommend all hospital kitchen staffs the use of hearing protection equipment while working in the kitchen.

CHAPTER 1:

INTRODUCTION

1.1 INTRODUCTION

Noise is the perception of unpleasurable sound. It is known to be one of the commonest environmental and occupational hazards. Studies have shown that noise can bring multiple negative impact to human health. This includes cardiovascular diseases such as hypertension and cardiac arrhythmia, neurological problems such as sleep disturbances, attention deficit and poor memory, gastrointestinal diseases such as gastric or duodenal ulcers, impaired wound healing or even causing Noise Induced Hearing Loss (NIHL).(Christensen, 2002; Goines & Hagler, 2007; Krachman, D'Alonzo, & Criner, 1995; Morrison, Haas, Shaffner, Garrett, & Fackler, 2003; Topf & Thompson, 2001)

Globally, noise induced hearing loss formed approximately 16% of total hearing impairment.(Nelson, Nelson, Concha-Barrientos, & Fingerhut, 2005) In Malaysia, there is recorded an increasing trend of NIHL from 2008 to 2012.(Norazimah & B. Badrul, 2014) During the initial noise exposure, hearing loss is often temporary. This type of NIHL is known as temporary threshold shift (TTS) and often resolved within 10-15 days after exposure. TTS will become permanent threshold shift (PTS) if the exposure persists.(Taneja, 2014) It is usually irreversible, caused by degeneration of hair cells due to repetitive noise exposure.(Nabeel, Md Daud, Mohammad, & Abd Rahman, 2017)

In normal hearing, once sound waves reached inner ear, there will be mechanical shearing force over the stereocilia of the hair cells seated on the basilar membrane. Deflection of the stereocilia will cause the opening of potassium channels. Influx of potassium and later

the calcium will depolarize the membrane and thus create electrical impulses to a higher centre for the perception of sound.

The pathophysiology of noise induced hearing loss is complex and remain controversial.(John C.W. & Raymond W.C., 2018) It can be temporary, described as temporary threshold shift (TTS) or permanent, known as permanent threshold shift (PTS). For TTS, Yamashita et al stated that it is mainly due to the metabolic mechanism which patient will recover. For PTS, there are structural changes which are permanent.(Yamashita, Miller, Jiang, Minami, & Schacht, 2004)

For the metabolic mechanism, Chen et al mentioned that in acoustic overstimulation, excessive release of glutamate may contribute to NIHL, as he noticed a reversal of TTS upon glutamate receptor antagonist administration.(G. Di Chen, Kong, Reinhard, & Fechter, 2001) Secondly, the reduction of cochlear blood flow upon loud noise might be another contributing factor as mentioned by Lamm et al. Another possible contributing factor includes oxidative stress, and possible role of glucocorticoid receptors.(John C.W. & Raymond W.C., 2018; Yamane et al., 1995)

For the structural mechanism, cochlear micromechanical structure changes had been observed. Depolymerization of actin filaments in stereocilia might be the cause.(John C.W. & Raymond W.C., 2018) Swollen mitochondria and nuclei, stereocilia disruption, vacuolization and cytoplasmic vesiculation that were observed in metabolic destruction might also contribute to the structural change.(Kim et al., 2014; Spoendlin, 1985) With enough noise duration and intensity, the entire organ of Corti might be disrupted.(Hirose & Liberman, 2003)

NIHL is commonly occupational in origin. Many occupations such as factory operators, military personnel, and airport workers are well known to be exposed to hazardous noise.(Ibrahimzubil A.R., Nor Hassim I., 2013; Sam, Anita, Hayati, Haslinda, & Lim, 2017; Tahir, Aljunid, Hashim, & Begum, 2014) Since 1989, Malaysia has established Factories and Machineries (Noise Exposure) Regulations. Multiple studies have been done in various locations regarding the risk and prevalence of hearing loss.

In a study done by Tan et al published in 2017 who discussed noise induced hearing loss (NIHL) effect among workers in small medium enterprises (SME) in Malaysia. In this study, up to 76.47% workers who's exposed to noise had noise induced hearing loss.(Rong, Hassim, & Halim, 2017)

Study of NIHL among quarry workers in a North-Eastern State of Malaysia by Ahmad et al in 2013 however showed prevalence of 57%. Out of which, 42% had mild to moderate hearing loss and 16% were having severe hearing loss.(Filza Ismail, Daud, Ismail, & Abdullah, 2013)

Another study by Nasir et al in 2012 who examined hearing loss among airport workers in Malaysia reported that 41.6% of the screened personal had had a certain degree of noise induced hearing loss.(Nasir & Rampal, 2012)

Kitchen is an essential in everyone's living. It's involved in food preparation, cooking, and cleaning after that. There are multiple potential source of hazardous noise production in

the kitchen including ventilation systems, compressor, noise produced while various types of cooking, and dishwashing equipment.(Achutan, 2009) Furthermore, there is also an addictive effect of intermittent noise production from metal to metal contact, rolling of carts on the floor and blenders noise, it is no doubt that kitchen is a noisy place.(Achutan, 2009) Worker such as cooks, kitchen assistant who work in the kitchen are thus having prolonged exposure to noise hazard.

In facility like a hospital, the number of patients and staffs can often go up to a few thousands. For optimum care and recovery of the patient, dietary needs of various patients must be fulfilled multiple times a day. Hospital kitchen is thus commonly big, and so do the noise hazard along with it. Studies have shown that the average noise level in some kitchen can go up to 90.5dBA to 92.9dBA.(Lao et al., 2013)With worker often required to stay long in that environment, it is no doubt that they can have various levels of noise induced hearing loss. Till date, there are only a few studies done regarding the noise level of different department in Malaysian Hospitals such as emergency department, intensive care unit and operating theatre, but no studies have yet to be performed specifically in a hospital kitchen on its prevalence of NIHL in Malaysia.(Busch-Vishniac et al., 2005; Din, 2013; Konkani & Oakley, 2012; Razali A, Herman H.P., 2017)

CHAPTER 2:

OBJECTIVES

2.0 OBJECTIVES OF THE STUDY

2.1 General Objective

To study on noise induced hearing loss (NIHL) among hospital kitchen staff compare to other staff in East Coast Malaysia Hospital.

2.2 Specific Objectives

1. To determine and compare the prevalence of NIHL among hospital kitchen staff and other non-kitchen working hospital staff.
2. To determine the percentage of NIHL in different frequency among hospital kitchen staff. (3kHz or 4kHz or 6kHz)
3. To associate between severity of the hearing impairment with duration of service in hospital kitchen.

CHAPTER 3:

MANUSCRIPT

3.1 COVER LETTER

February 17, 2021

Andrew J. Oxenham

Editor in Chief

Trends in Hearing

Dear Mr Oxenham,

I am submitting a manuscript for consideration of publication in Trends in Hearing. The manuscript is entitled “Prevalence of Noise Induced Hearing Loss among kitchen staff in Malaysia East Coast Hospital”.

This is the first multicenters and most comprehensive study that is done on noise induced hearing loss among hospital kitchen staffs in Malaysia. Results of this study not only will be the firm basis and guidelines for future construction of hospital kitchen with its instruments, it will also reminds everyone such occupational hazard, thus strengthen the prevention of these hearing loss.

This manuscript has not been published and is not under consideration for publication in any other journal. All authors approved the manuscript and its submission to the journal “Trends in Hearing”.

Thank you Very much for your consideration.

Yours Sincerely,

Dr Lo Ren Hui

rh_920@hotmail.com

3.2 TITLE PAGE

PREVALENCE OF NOISE INDUCED HEARING LOSS AMONG KITCHEN STAFF IN MALAYSIA EAST COAST HOSPITAL

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3.3 ABSTRACT AND KEYWORDS

Noise can be hazardous as it is known to cause hearing loss. Kitchen especially hospital kitchen is one of it that produce tremendous noise pollution. Long hours of working in hospital kitchen may potentially lead to hearing loss. The objective of this study is to study on noise induced hearing loss (NIHL) among hospital kitchen staff compare to other staff in East Coast Malaysia Hospital. This was a descriptive cross-sectional study. The source population was from kitchen staffs of 5 Malaysian East Coast Hospitals comparing to other hospital staffs (hospital clerk, clinical based medical attendant) of the same hospitals. The data were collected in outpatient clinics, fill the pro forma, otoscopic examination and hearing test using pure tone audiometry. A total of 123 hospital kitchen staffs and 122 other hospital staffs participated in this study. There was a significant correlation of noise induced hearing loss among the hospital kitchen staffs (54.3%) compared to the other group (27%). The dip on pure tone audiometry was mostly at 6kHz, followed by 4kHz and 3 kHz. There was a significant mean difference of years of service between groups (mild, moderate, severe) of severity hearing impairment (p=0.010). This study showed that hospital kitchen noise is hazardous to staffs that working on it. Kitchen staffs will have a worse hearing loss following longer working years. We recommend all hospital kitchen staffs to use hearing protection equipment while working in the kitchen.

Keywords: Noise Induced Hearing Loss, Kitchen Noise, Occupational Hazard

3.4 MAIN BODY

3.4.1 INTRODUCTION

Noise is the perception of unpleasurable sound. It is known to be one of the commonest environmental and occupational hazards. Studies have shown that noise can bring multiple negative impact to human health. This includes cardiovascular diseases such as hypertension and cardiac arrhythmia, neurological problems such as sleep disturbances, attention deficit and poor memory, gastrointestinal diseases such as gastric or duodenal ulcers, impaired wound healing or even causing Noise Induced Hearing Loss (NIHL).(Christensen, 2002; Goines & Hagler, 2007; Krachman et al., 1995; Morrison et al., 2003; Topf & Thompson, 2001)

Globally, noise induced hearing loss formed approximately 16% of total hearing impairment.(Nelson et al., 2005) In Malaysia, there is recorded an increasing trend of NIHL from 2008 to 2012.(Norazimah & B. Badrul, 2014) During the initial noise exposure, hearing loss is often temporary. This type of NIHL is known as temporary threshold shift (TTS) and often resolved within 10-15 days after exposure. TTS will become permanent threshold shift (PTS) if the exposure persists.(Taneja, 2014) It is usually irreversible, caused by degeneration of hair cells due to repetitive noise exposure.(Nabeel et al., 2017)

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NIHL is commonly occupational in origin. Many occupations such as factory operators, military personnel, and airport workers are well known to be exposed to hazardous noise.(Ibrahimzubil A.R., Nor Hassim I., 2013; Sam et al., 2017; Tahir et al., 2014) Since 1989, Malaysia has established Factories and Machineries (Noise Exposure) Regulations. Multiple studies have been done in various locations regarding the risk and prevalence of hearing loss.

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Kitchen is an essential in everyone's living. It's involved in food preparation, cooking, and cleaning after that. There are multiple potential source of hazardous noise production in the kitchen including ventilation systems, compressor, noise produced while various types of cooking, and dishwashing equipment.(Achutan, 2009) Furthermore, there is also an addictive effect of intermittent noise production from metal to metal contact, rolling of carts on the floor

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In facility like a hospital, the number of patients and staffs can often go up to a few thousands. For optimum care and recovery of the patient, dietary needs of various patients must be fulfilled multiple times a day. Hospital kitchen is thus commonly big, and so do the noise hazard along with it. Studies have shown that the average noise level in some kitchen can go up to 90.5dBA to 92.9dBA.(Lao et al., 2013)With worker often required to stay long in that environment, it is no doubt that they can have various levels of noise induced hearing loss. Till date, there are only a few studies done regarding the noise level of different department in Malaysian Hospitals such as emergency department, intensive care unit and operating theatre, but no studies have yet to be performed specifically in a hospital kitchen on its prevalence of NIHL in Malaysia.(Busch-Vishniac et al., 2005; Din, 2013; Konkani & Oakley, 2012; Razali A, Herman H.P., 2017)

3.4.2 METHODOLOGY

In this study, for the subject group, all hospital kitchen staffs including cooks and kitchen assistants (HSNZ, Hospital Kemaman, Hospital Besut, HTAA and Hospital USM) were recruited for the study. For the comparative group, a simple random sampling method was used. All available clerical staffs (HSNZ, Hospital Kemaman, Hospital Besut, HTAA and Hospital USM) were listed and selected randomly by picking lots.

All participants were required to be free from work for at least 48 hours prior to the study. Upon presentation, participants' demographic data and personal detail histories were taken, including both inclusion and exclusion criteria. Only participants fulfilling inclusion, but not exclusion criteria will be recruited for the study.

Table 3.4.1: Screening for inclusion and exclusion criteria for study group

Inclusion Criteria:
1. Cook and kitchen assistant
2. Working at least 6 months or above in the working area stated above.
3. Must be 55 years old and below.
Exclusion Criteria
1. Family history of early onset hearing loss
2. History of other occupational noise exposure
3. Known history of exposure to recreational noise
4. Known history of receive systemic ototoxic drugs
5. Chronic ear disease detected during ear examination
6. Known history of otological operation

Table 3.4.2: Screening for inclusion and exclusion criteria for comparative group

Inclusion Criteria:

1. Hospital Clerk and clinical based medical attendant
2. Working at least 6 months or above in the working area stated above.
3. Must be 55 years old and below.

Exclusion Criteria

1. Family history of early onset hearing loss
2. History of other occupational noise exposure
3. Known history of exposure to recreational noise
4. Known history of receive systemic ototoxic drugs
5. Chronic ear disease detected during ear examination
6. Known history of otological operation

Consent was then taken from all participants. Participation in this study was completely voluntary. This was followed by ear examination, including otoscopic examination to rule out any ear diseases. Finally, pure tone audiometry and tympanometry were performed by qualified audiologists. All demographic data, participants personal histories, examination findings and pure tone audiometry results will be recorded in patient's pro forma.

Hearing loss was classified into six categories following its hearing threshold according to International Bureau Audiophonology 1996. Namely normal 0-20dB, mild hearing loss 21-40dB, moderate hearing loss 41-70dB, severe hearing loss 71-90dB, very severe hearing loss 91-119dB and total hearing loss (cophosis) if 120dB or more.(BIAP, 1996)

Descriptive analysis, prevalence and the proportion of NIHL was calculated at different frequencies. (3kHz, 4kHz, 6kHz) Finally, data analysis was done using SPSS software version 22.0. One way ANOVA test was done and followed by post HOC multiple comparison test.

3.4.3 RESULTS

In this study, a total of 128 hospital cooks and kitchen assistants were recruited for the study from 5 Malaysia East Coast Hospitals including Hospital Tengku Ampuan Afzan, Hospital Kemaman, Hospital Sultanah Nur Zahirah, Hospital Besut and Hospital Universiti Sains Malaysia. For the comparative groups, a total of 142 clerks and clinical based medical attendants were recruited from these five hospitals.

Strict inclusion and exclusion criteria were followed. 5 from the study group and 20 from the comparative group were excluded from this study mainly because of previous other occupation with potential risk of noise exposure such as working in the car factory or textile factory for more than 6 months, recreational noise exposure such as heavy metal band participation or motor racing, and history of ototoxic drug intake such as aspirin and frusemide.

Thus, a total of 245 samples were recruited for this study. The data obtained was expressed as mean with standard deviation (SD) for numerical variables and frequency(n) with percentage (%) for categorical variables as tabulated in Table 3.5.1. The mean age of total sample was 37.33 with standard deviation of 8.16 for hospital kitchen staff and mean of 39.15 (SD=7.02) for other hospital staff in the five centers under studied. The result of the data showed that there were more than half female (n=76, 61.8% vs n=103, 84.4%) for kitchen and non-kitchen hospital staff respectively from the total population studied.

Table 3.5.1: Participants' demographic data (n=145).

Profile	Hospital Kitchen Staff		Other Hospital Staff	
	Mean (SD)	n (%)	Mean (SD)	n (%)
Age	37.33(8.16)		39.15(7.02)	
Gender				
Male		47(38.2)		19(1.56)
Female		76(61.8)		103(84.4)
Race				
Malay		122(99.2)		121(99.2)
Chinese		1(0.8)		1(0.8)
Years of service	11.95(7.33)		14.58(6.88)	

The prevalence of NIHL among hospital kitchen staff and other hospital staff was summarized in Table 3.5.2.

Table 3.5.2: Prevalence of NIHL in each group.

Group	Prevalence of NIHL (95%CI)
Hospital Kitchen Staff	55.3(0.46,0. 64)
Other Hospital Staff	27.0(0.19,0.35)

Based on Table 3.5.2, the prevalence of Hospital kitchen staff which suffered from NIHL was more than doubled compared to other hospital staff (55.3% vs 27.0%).

Descriptive statistics was used to describe the distribution of staffs with NIHL in each group under studied (kitchen vs non-kitchen hospital staff) for each frequency as shown in Table 3.5.3 below.

Table 3.5.3: The percentage of NIHL in different frequency (3kHz or 4kHz or 6kHz)

Group	3kHz n(%)	4kHz n(%)	6kHz n(%)
Hospital Kitchen Staff	25(21.1)	41(33.3)	55(44.7)
Other Hospital Staff	19(15.6%)	24(19.7)	32(26.2)

Association of duration of service in hospital kitchen based on severity of the hearing impairment. One Way ANOVA test was used to examine the mean difference of years of service of the hospital kitchen staff between groups of severity NIHL as shown in Table 3.5.4.

Table 3.5.4: Comparison of severity of NIHL with years of working by using ANOVA test

NIHL	Years of Service Mean (SD)	F-Statistic (df)	P value
Mild	12.91(8.04)	4.91(2, 65)	0.010
Moderate	18.00(6.07)		
Severe	23.50(7.94)		
Profound	-		

*Post hoc comparison using Tukey shows significant mean difference between mild and severe group (mean difference=-10.59(95%CI=-20.25, -0.93), p=0.028).

Based on Table 3.5.4, there were significant mean difference of years of service between groups (mild, moderate, severe) of severity hearing impairment (p=0.010). The highest duration of service was in group severe NIHL with mean of 23.0 years (SD=7.94) compared to mild and moderate group. Post hoc comparison using Tukey to further describe the association shows that severe group were significantly higher in mean duration of service compared to mild group with mean difference of 10.59 (95%CI=-20.25, -0.93, p=0.028).

3.4.4 DISCUSSION

In this study, the number of recruited hospital kitchen staffs accounted for 60.89% of total kitchen staffs (n=123/202), which allowed for a reasonable estimation of the true hearing status of Malaysia East Coast Hospitals kitchen Staffs. The age range and mean for both hospital kitchen staffs (23 years old to 55 years old, mean 37.33) and other hospital staffs (22 years old to 55 years old, mean 39.12) were also comparable. This made the comparison reasonable.

However, there were differences in terms of race and gender. For race of recruited participants, both groups showed significant Malay preponderance (99.2% in both groups). This was likely due to the location of the study which situated at Malaysia East Coast with vast majority of Malays. For gender of recruited participants, both groups were mainly female. (61.8% in study group, 84.4% in comparative group). This was likely due to the nature of the occupation and culturally more female preferred to work in kitchen, as hospital clerk or medical attendant compared to other occupations in East Coast Malaysia.

In the study, the number of participants who had hearing loss was significantly higher in the study group with over 2 times difference compared to the other group. A total of 68 over 123 hospital kitchen staffs had hearing loss (54.47%). For the hospital non kitchen comparative group, 33 over 122 participants had hearing loss (27%). This means hospital kitchen noise had been causing significant impact on workers' hearing level.

Based on Table 3.5.4, there were significant mean difference of years of service between groups (mild, moderate, severe) of hearing impairment (p=0.010). The highest duration of service was in severe NIHL group with a mean of 23.0 years (SD=7.94) compared to mild and moderate group. Post hoc comparison using Tukey to further describe the association shows that severe group was significantly higher in mean duration of service compared to the mild group with a mean difference of 10.59 (95%CI=-20.25, -0.93, p=0.028).

According to Occupational Safety and Health (Noise Exposure) Regulations 2019, published by Department of Occupational Safety and Health, Ministry of Human Resource Malaysia, it stated that all employers shall ensure that none of his employee is exposed to (a) daily noise exposure level exceeding 85dB(A) or daily personal noise dose exceeding 100 percent; (b) the maximum sound pressure level exceeding 115dB(A) at any time; or (c) the peak sound pressure level exceeding 140dB(A). National Institute for Occupation Safety and Health (NIOSH) of the United States of America had also stated that exposure of occupational noise of more than 85dB(A) over 8 hours carries risk of NIHL. In the study, all 5 hospital kitchen staffs working duration were similar.(Kiersma, 2014) Workers were required to work for 7-8 hours in the kitchen per shift per day.

Studies had shown that kitchen can be noisy with possible sound pressure level reaching 92.9dB(A).(Lao et al., 2013) Furthermore, hospital kitchens especially tertiary hospitals are required to serve few thousand people per meal, a few times a day. Kitchen has been thus often very busy. With persistence noise exposures from compressors, large ventilation systems, close contact of various utensils, there is no doubt that significant higher number of kitchen staffs in this study suffer noise induced hearing loss.

The possible pathophysiology of hearing loss was complex.(John C.W. & Raymond W.C., 2018) For our study group, we observed hospital kitchen workers had had worse hearing loss if the duration of service was longer. This could be explained with a few reasons. Firstly in PTS, there were micromechanical structural changes within cochlear and additional effect such as swelling of stria vascularis, afferent nerve endings and supporting cells.(Lim, 1986) Furthermore, there were also evidence of apoptosis and necrosis led to hair cell death, particularly outer hair cells at basal turn. These hair cells loss was not regenerable.(Le, Straatman, Lea, & Westerberg, 2017). Long term accumulation of hair cells death due to repetitive exposure to noise likely contributed to the progressive worsening severity of hearing impairment in relation to the exposure duration of Hospital Kitchen Staffs.

In case if the daily noise exposure level did not exceed sound pressure level of 85dB(A) persistently in certain kitchen, with the Asian way of cooking, there would be frequent production of sudden loud noise intermittently such as hitting of cooking spatula with the wok. These overstimulation of hair cells would cause excessive release of glutamate, inflammation with endolymphatic hypoxia, and production of reactive oxygen species, leading to cell death, and thus worsening of irreversible permanent hearing loss.(Yamasoba, Nuttall, Harris, Raphael, & Miller, 1998)

Among the hospital kitchen staffs, there were 55 participants with 6kHz hearing loss (44.7%), followed by 41 participants with 4kHz hearing loss (33.3%) and 25 participants with 3kHz hearing loss (21%). For the comparative participants, there were 32 participants with 6kHz hearing loss (26%), 24 participants with 4kHz hearing loss (19%) and 19 participants