THE IMPACT OF UNDETECTED HEARING LOSS AND EAR DISEASES ON ACADEMIC PERFORMANCE AMONG STANDARD 6 STUDENTS OF SEKOLAH KEBANGSAAN KUBANG KERIAN 3

BY

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LIST OF ABBREVIATIONS

CGPA	=	cumulative grade point average
CHL	=	conductive hearing loss
dB	=	decibel
DPOAE	=	Distortion Product Otoacoustic Emissions
GPA	=	grade point average
HUSM	=	Hospital Universiti Sains Malaysia
Hz	=	Hertz
NIHL	=	Noise Induced Hearing Loss
IHCs	=	Inner hair cells
JCIH	=	Joint Committee on Infant Hearing
kHz	=	kiloHertz
ORL	=	Otorhinolaryngology
OAE	=	Otoacoustic emission
OHCs	=	Outer hair cells
AOM	=	Acute otitis media
PTA	=	Pure tone audiometry
SFOAE	=	Stimulus Frequencies Otoacoustic Emissions
SNHL	=	Sensorineural hearing loss
TEOAE	=	Transient Evoked Otoacoustic Emissions
UPSR	=	Ujian Pencapaian / Penilaian Sekolah Rendah
UNHS	=	Universal Neonatal Hearing Screening

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ABSTRAK

Objektif

Dalam kajian ini, objektif utama adalah untuk menentukan kadar peratusan masalah pendengaran dan penyakit telinga dalam kalangan pelajar Tahun 6 di Sekolah Kebangsaan Kubang Kerian 3 dan hubungkait dengan pencapaian akademik.

Metodologi

Kajian dilakukan secara hirisan lintang di SKKK3, Kubang Kerian, Kelantan pada tahun 2008. Peserta menjalani ujian dengan menggunakan alatan "Distortion Product Otoacoustic Emission" (2, 3, 4 and 5 kHz) dan pemeriksaan telinga pada peringkat pertama bagi tujuan saringan bagi mengesan kehadiran masalah pendengaran. Peserta yang gagal peringkat pertama akan menjalani ujian peringkat kedua iaitu "Pure Tone Audiogram" (0.25 to 8 kHz). Tahap pendengaran pelajar telah dibandingkan dengan tahap pencapaian akademik pelajar dengan menggunakan tiga cara: pembahagian kelas mengikut pencapaian peperiksaan akhir tahun, pencapaian UPSR, dan pencapaian Bahasa Melayu (UPSR).

Keputusan

Daripada keseluruhan 232 pelajar tahun enam, hanya 193 pelajar sahaja menyertai kajian ini dan telah disaring pada tahap pertama. Kekerapan penyakit telinga ialah 15% (29 peserta). Lilin telinga termampat merupakan masalah telinga utama diikuti oleh penyakit 'chronic suppurative otitis media'. Bagi masalah pendengaran, kekerapan masalah pendengaran bagi saringan pertama dengan ujian OAE dan pemeriksaan telinga adalah sebanyak 9.8% tetapi pada saringan kedua dengan ujian PTA adalah sebanyak 10.3%.

Kekerapan peningkatan ujian OAE selepas intervensi adalah sebanyak 65.4%. Bagi masalah pendengaran yang boleh dirawat, peningkatan tahap pendengaran adalah sebanyak 56.5%. Bagi masalah pendengaran yang tidak dapat dirawat, 100% tiada peningkatan dalam tahap pendengaran. Masalah pendengaran dan pencapaian akademik mempunyai hubungkait yang penting dengan menggunakan pembahagian kelas (P = 0.006).

Kesimpulan

Hasil dari kajian ini, menunjukkan bahawa terdapat penyakit telinga dan masalah tahap pendengaran di kalangan peserta yang tidak dapat dikesan sebelum ini. Perhatian yang serius perlu diberikan untuk mengatasi masalah ini memandangkan rawatan awal boleh memulihkan tahap pendengaran. Kebanyakan ibubapa dan pelajar sedar akan adanya masalah pendengaran, tetapi kurang pengetahuan dan rujukan menyebabkan masalah pendengaran ini tidak dikesan awal, yang kemudiannya memberi kesan kepada akademik pelajar. Pendidikan dan pengetahuan mengenai cara-cara penjagaan telinga yang betul dan program saringan masalah pendengaran pada peringkat awal perlu di tekankan.

ABSTRACT

Objectives

To determine the prevalence of hearing impairment and ear diseases in standard 6 students of Sekolah Kebangsaan Kubang Kerian 3 (SKKK3) and its association with academic performance.

Methodology

It was a cross-sectional study with follow-up, carried out at SKKK3, Kubang Kerian, Kelantan in 2008. Distortion Product Otoacoustic Emission (2, 3, 4 and 5 kHz) and Otological Examination were perform in first stage for the purpose of screening the presence of hearing loss. Participants that failed the first stage will undergo secondary screening which was Pure Tone Audiometry (0.25 to 8 kHz). Participant's hearing level was compared with their learning performance using three methods: class streaming based on year-end assessment, Ujian Pencapaian Sekolah Rendah (UPSR) results and Bahasa Melayu UPSR results.

Results

From overall 232 standard six students, only 193 students participated in this study and were screened in the first stage. The prevalence of ear diseases was 15% (29 participants). Impacted wax was the commonest ear disease found (8.8%) followed by chronic suppurative otitis media (2.6%). For the hearing impairment, the prevalence of hearing impairment by primary screening with OAE test and otological examination was

9.8% but following the secondary test with PTA, the prevalence was 10.3%. After intervention with repeat OAE, 68.4% was improved. For treatable cause of hearing loss, 56.5% had improvement in hearing level. For non-treatable cause, 100% had no improvement in hearing level. A significant association between hearing loss and academic performance was found using the class streaming method (P = 0.006).

Conclusion

Results from the study had shown the prevalence of ear diseases and mild hearing impairment among participants that was never been detected before. Effort should continue even harder to tackle the problems because the earlier the treatment the better outcome will be achieved. Providing education toward good ear care and screening program to detect hearing impairment as early as possible and thus early intervention and rehabilitation can be carried out.

CHAPTER 1:

INTRODUCTION

1.0 INTRODUCTION AND LITERATURE REVIEW

1.1 Introduction

Deafness and hearing impairment are major causes of disability in developing countries. Unfortunately, they are generally neglected in comparison with other disabling conditions. The reasons for this neglect are multiple. Principally, this is because hearing impairment produce unseen disability. There is a lack of awareness of the possibilities for prevention as well as uncertainty about the most appropriate methods for treatment and rehabilitation. There is also ignorance of the true size and nature of the problems and lack of resources to tackle these problems.

It was estimated that at least 250 million people having hearing loss globally which account about 4% of the world population (Kumar S, 2001). Majority of them live in part of world which are the developing countries with limited facilities and resources needed for investigation, management and proper diagnosis. Mild hearing impairment is a hidden pathology that led to ignorant and lack of awareness among people which make the condition remains undetected. Inaccessible and lack of facilities is one of the factors that lead to ignorance and late detection.

An inappropriate health care, low education level and low socioeconomic status are all lead to the inability to cope with such a significant problems, hence cases were unidentified and poorly managed (Prasansuk S, 2000). Those who suffer from malnutrition, ear infection and poor knowledge of ear care would eventually develop hearing impairment and chronic ear disease. Many of the school children with hearing loss are not identified due to no specific physical symptoms and no special hearing

screening programs. The condition went on unnoticed and untreated, will later on impair children's ability or performance either at academic level, occupations and interpersonal relationship.

Majority of the hearing impairment and ear diseases are avoidable and reversible or at least can be reduced from worsening if the proper screening and management could be carried out at initial stage of identification. A randomised controlled trial was done to examine the effect of treatment on language related outcomes in children recruited to the trial at the time of their first appointment at an otolaryngology clinic based on Canadian Task Force on Preventive Health Care. Seventy six children with bilateral effusions and hearing loss were documented prospectively for at least three months, after which children were randomised to receive ventilation tubes within six weeks, or, if required, after a period of nine months of "watchful waiting". Nine months after randomisation, those assigned to the watchful waiting group had verbal comprehension and expressive language skills that were 3.24 months behind those in the early surgery group. Eighteen months after randomisation, 85% of the watchful waiting group had undergone tube insertion, and the groups no longer differed significantly with regard to language related outcomes (Davis R.L, 2000). This significantly indicates that early intervention may reverse the hearing outcome.

Hearing impairment affects all age groups. Around one in 850 children is born with significant, permanent hearing impairment, and this proportion doubles during the first decade or so of life as further children developed progressive hearing loss. The number of hearing-impaired individuals increases with each additional decade, until as many as 60% of the over 70 age group show a 24 dB or worse permanent threshold level (Davis

A, 1998). Thus, a very large proportion of the population suffers some degree of hearing impairment at some stage of their life.

Deafness is a serious handicap in pediatric age group especially if it developed at birth or early life that can lead to social and communication isolation. It is considered as significant if the degree of hearing loss would have an impact on normal speech and language developments. Failure to detect moderate bilateral permanent hearing loss (>40kb) in early childhood may result in life-long deficits in speech, poor academic performance, personal-social maladjustment and emotional difficulties. It also has adverse effects on social, emotional and academic development with a high cost to society. Even children with mild or unilateral permanent hearing loss may experience difficulties with speech, language, educational and psycho-social development (Olusanya B.O, 2003).

Due primarily sensory deprivation, children with hearing impairment have been shown to be significantly slower in developing receptive vocabulary than the peers with normal hearing (Wake M. *et al*, 2006). In Swaziland, from approximately 30000 children enrolling annually at school for the first time, 20% had drop out after only one year of schooling. This has been related to disability of hearing impairment (Swart S.M. *et al*, 1995).

A child's ability to hear influences the development of communication and behavioural skills that affect educational experience and relationships with other people. Public health screening and intervention play an important role in improving the health (including hearing status) and well-being of children. Children are most often administered audiometric evaluations at speech frequencies as part of routine physical examinations or in school settings. The majority of conductive hearing loss affects the

low frequencies, while the majority of sensorineural hearing loss affects the high frequencies. Impacted wax, a foreign body, oedema of the auditory canal, and otitis media are just a few of many possible causes of conductive hearing loss among children. Noise, medications, meningitis, and congenital syphilis are among the many possible causes of sensorineural hearing loss among children. Studies have shown that high-frequency hearing loss from noise exposure during childhood can lead to further hearing loss from acute or chronic noise exposure at older ages.

At present in Malaysia, school children with mild hearing loss are not identified and remained undetected as there is no mandatory school hearing screening programs yet and children with mild hearing loss mostly have non-specific physical symptoms or findings.

1.2 Definition of Hearing Loss

According to WHO (2006), (Anonymous, 1997), hearing loss is defined as below:

- **Hearing impairment**
  - A defective auditory function
- **Hearing disability**
  - The auditory problem experienced and complained of by the individual in performing basic tasks eg: difficulty communicating in a noisy environment
- **Hearing handicap**
  - The non-auditory consequences of hearing impairment and hearing disability that would impact on a person from doing a normal role in daily life involving occupational, phychosociological and economical activities.
- **Deafness**
  - Complete loss of ability to hear from one or both ears

Terms 'disabling hearing impairment' in adult as a permanent unaided hearing threshold level of 41 dB or more in better ear while in children under 15 years of age is a permanent unaided hearing threshold level of 31 dB or more in the better ear. The average or four frequencies of 500Hz, 1, 2 and 4 kHz are to be taken as hearing threshold level.

1.3 Degree of Hearing Loss

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

According to WHO classification, the degree of the hearing impairment has been design as in Table 1.

Table 1: Degree of hearing loss according to WHO classification.

Degree of Hearing Loss	**Decibel (dBHL)**
Normal	0-25
Mild	26-40
Moderate	41-60
Severe	61-80
Profound	>80

Some centres use a different value in classifying the degree of hearing loss, based on their population and preferences. Such as in Hospital Universiti Sains Malaysia practice as in Table 2, however in our study the WHO classification is used to standardised our data with other literature.

Table 2: Degree of hearing loss used in Hospital Universiti Sains Malaysia.

Degree of Hearing Loss	Decibel (dBHL)
Normal	**0-20**
Mild	**21-40**
Moderate	**41-70**
Severe	**71-90**
Profound	**>90**

1.4 Types of Hearing Loss

Deafness can be broadly categorized into **syndromic** (deafness associated with other syndromes) or **non-syndromic** (deafness associated with no other symptoms) (Micheal Gleeson, 2008). Clinically, deafness or hearing loss is generally categorized on the basis of which auditory structures are affected. It can be classified into **conductive, sensorineural and mixed hearing loss** (including both component of conductive and sensorineural) which can be congenital or acquired. Conductive hearing loss (CHL) refers to defects found in the outer or middle ear that interferes the transmission of sound to the cochlea , whereas sensorineural haring loss (SNHL) refers to disruptions in sounds transmission from the inner ear to the cortex of the brain due to the lesions of the cochlea, 8^{th} cranial nerve or central auditory pathways. Most SNHL is due to

abnormalities at the level of the inner ear. Inner ear pathology is further categorized into three groups: morphogenetic, cochleo-saccular and neuroepithelial (Steel KP, 2001).

1.5 Risk factors and Aetiology of Hearing Loss

Hearing loss has been the commonest congenital abnormality in newborns, more than twice as prevalent as other conditions, which are screened for at birth such as phenylketonuria, sickle cell disease, hypothyroidism and galactosaemia combined. Permanent congenital hearing loss (PCHL) could occur during or shortly after birth as early-onset, or could manifest postnatally as late-onset, progressive or acquired hearing loss with varying degrees of severity. The period from birth to five years is often viewed as the 'critical phase' for the development of language. Hearing during the first six months of life is also considered as crucial for normal acquisition of language. Hence, infants with permanent congenital and early-onset hearing loss (PCEHL) identified by six months of age and given appropriate and timely support are reported to achieve better language outcomes than those identified later than six months of age. In contrast, children detected late may never catch up with their normal-hearing peers in their academic, social and emotional development even with the best of rehabilitation. Consequently, the detection of significant bilateral hearing loss in infants before three months of age, followed with appropriate intervention not later than six months of age, is now being considered as an essential component of primary healthcare delivery.

There are three important risk factors associated with hearing impairment in children. The most important is a history of staying in the neonatal intensive care unit (29%), the second common risk factor is a family history of hearing loss that account about 26%

and third after excluding the above two factors, the presence of a craniofacial abnormality noticeable at birth (4%) (Davis R.L *et al*, 2000).

Known cause of hearing loss are multiple. The risk of congenital or delayed onset sensorineural hearing impairment include any of the following (Joint Committee on Infant Hearing 1994):

- Family history of hereditary childhood sensorineural hearing loss
- Intrauterine infection e.g. rubella, toxoplasmosis, cytomegalovirus, herpes and syphilis
- Craniofacial anomalies including morphologic abnormalities of the pinna and ear canal
- Birth weight less than 1.5 kg
- Hyperbilirubinemia requiring exchange transfusion
- Ototoxic medications e.g. multiple course of aminoglycosides usage or in combination with loop diuretics
- Bacterial meningitis
- Head trauma association with temporal bone fracture
- Mechanical ventilation for 5 days or more
- Association with syndromic child

Chronic otitis media, recurrent acute otitis media, otitis media with effusison and impacted wax, are some of the common diseases associated with reversible hearing loss in infants and school-age children.

In the study on deafness in Swaziland, Gell A *et al* (2000) reviewed attitudes toward deafness and people with hearing impairment, particularly in African countries. She examined not only the attitudes themselves but also the reasons for the formation of such attitudes within a community. These reasons fall largely into three categories: socioeconomic conditions, lack of understanding about the nature of disability, and beliefs about the origin of the disability. In some societies, such as among the Yoruba of Nigeria, the mother is blamed for her child's deafness. This has a tendency to lead to the concealment of the condition or of the child. Beliefs that the child's impairment is punishment for sins committed by the parents or by earlier generations, as in Tanzania, mean that the child can therefore become the evidence of the sin and again may be hidden. In other cultures, the disability is perceived as ordained by God and must be accepted as destiny. Besides that, the lack of understanding of the development of deafness can lead to beliefs that it could be contagious, and it has been found that, in some parts of Tanzania, female teachers were unwilling to teach deaf children as they believed that their own children would be born deaf (Prasansuk S, 2001).

1.6 Epidemiology

The prevalence of hearing loss worldwide is not known. It has been estimated to range from as low as 40 million to as high as 300 million people. According to WHO (1997-2008), the number of Americans with a hearing loss has doubled during the past 30

years. A total of 278 million people worldwide have moderate to profound hearing loss in both ears.

This estimation is reasonably well within 1971 to 1993 trend line that evolved from Federal surveys (Table 3). Eighty percent of the deaf and hearing-impaired people live in low and middle-income countries. The number of people worldwide with all levels of hearing impairment is rising mainly due to a growing global population and longer life expectancies.

Table 3: Data gained from Federal surveys illustrate the following trend on prevalence of individuals aged three years or older.

Year	Prevalence
1971	13.2 million
1977	14.2 million
1991	20.3 million
1993	24.2 million
2000	28.6 million

Source: (WHO, 1997-2009)

Approximately, 126,000–500,000 babies are born each year with significant hearing loss and about 90% of them live in the developing countries. This figure can vary from 500,000–2,000,000 when the estimated total population of children (less than five years old) in year 2001 of 548,031,000 is considered (Olusanya B.O *et* al, 2003).

Swart S. M. *et al.* (1995) stated that "in Swaziland, the Ministry of Health and Education found that 20% of approximately 300000 children enrolling annually at school for the first time drop out after only one year of schooling. They believe that one of the factors that contribute for this is hearing impairment". The number of children with disabilities, ages 6 to 21 years old, served in the public schools under the Individuals with Disabilities Education Act (IDEA) Part B in the 2000-01 school year was 5,775,722. Out of these children, 70,767 (1.2%) received treatment for hearing. However, the number of children with hearing loss and deafness is undoubtedly higher, since many of these students may have other disabilities as well. Data by disability are not reported by the Department of Education for age's birth to 5 years. Several studies indicate variance in the prevalence of newborns with congenital hearing loss in the United States. Overall estimates are 1 to 6 per 1,000 newborns. Most children with CHL have hearing impairment at birth and are potentially identifiable by newborn and infant hearing screening. However, some congenital hearing loss may not become evident until later in childhood (WHO, 1997-2008).

In Malaysia, a study had been done to determine the prevalence of ear disease and hearing impairment in the population of Tumpat, Kelantan. A total subject of 204 (61% females and 39% males), 20.58% of the females and 15.20% of the males with a total of 17.31% were found to have hearing impairment (Noor N, 2000). Another study done to determine the prevalence of hearing impairment and ear disease in Kelantan shows 16.8% of 502 participants to have hearing impairment (Razali M.S, 2006). A study done in 2006 shows that from a total of 257 school children from different districts in Kuala Terengganu, 35.4% of them failed their first stage of hearing screening using Transient Evoked Otoacaustic Emission (TEOAE) and 14% were found to have hearing

impairment after undergoes their second screening using Pure Audiometry (PTA) test (Noor R.M , 2006).

Middle ear infection or otitis media (OM) is the most frequent medical diagnosis in children. OM is an inflammation in the middle ear that usually causes fluctuating hearing loss. The National Center for Health Care Statistics estimates 70 cases in every 100 children under five years old. It ranks second to the common cold in preschool children. Many children with a loss due to OM will pass a school screening test. It is not diagnosed 50% of the time. Almost all children have one episode by age six. Which 63% of them have a recurrence OM, 96% have OM in the first year of life and 85% have OM in the first six months. An estimated five million days are missed every year due to otitis media (Leach A.J. 1999). When a child has OM, the fluid that arises takes an average of 40 days to be absorbed or drain. If a child has chronic OM (4-5 episodes over a 6 to 12 month period), he/she could experience a possible 200 days of reduced hearing in a year. Thirty percent of students with learning disabilities have histories of chronic middle ear problems.

A study done by Davis R.L *et al* (2000) revealed that the prevalence of all permanent childhood hearing impairment is 133 per 100,000 and for congenital impairment is 112 per 100,000. The prevalence of profound congenital hearing loss is one in 400 life births. By the age of five years, about 20% of the profoundly hearing impaired children are due to acquired causes, mostly meningitis. As regards to the study, the etiology of congenital permanent hearing impairment in children as follows: in 41% there are unknown cause, 19% have an etiology with no genetic cause and 40% have an etiology with genetic cause.

A study was done to find out the prevalence and the causes of hearing impairment among children of school-entry age, in rural areas of coastal south India. A total of 855 children in the first year of school were examined using a Portable Pure Tone Audiometer and an otoscope. Children with hearing impairment were re-examined to find out the type of hearing impairment. The results shows that hearing impairment was detected in 102 children (11.9%) and impacted wax was found to be the most common cause of hearing impairment (86.3%). On re-testing, it was predominantly conductive hearing impairment (81.6%) observed among 74 of these children (Phaneendra R.S *et al,* 2002).

Another study done in Swaziland shows that from all Grade 1 (first year school entry) school children, 16.8% of them have ear disorder and 20% of them have abnormal hearing. The common disorder was impacted earwax (7.4%), followed by active middle ear disease (3.0%) and inactive ear disease (2.1%). Of this, they found that 0.8% has sensorineural hearing loss with 0.53% have unilateral and 0.21% have bilateral hearing loss (Swart S.M *et al,* 1995).

A total of 738,000 individuals in the US were found to have severe to profound hearing loss. Of these, almost 8% are under the age of 18. Among African-American, Cuban-American, Mexican-American, Puerto Rican, and non-Hispanic White children, it is estimated that approximately 391,000 school-aged children in the U.S. have unilateral hearing loss (Katz J *et al*, 2009). Niskar and colleagues found that there are approximately 14.9% of U.S. children have low-frequency or high-frequency hearing loss of at least 16dB hearing level in one or both ears. Profound, early-onset deafness is present in 4 to 11 per 10,000 children, and is attributable to genetic causes in at least 50% of cases (WHO, 1997-2008).

Brian *et al* determines the prevalence of significant hearing impairment in children attending primary school in the country of Zimbabwe. This study was a part of The Rotary Hearing Health Care Program. Primary schools in Manicaland were taken as a sample, and they were screened. Hearing level greater than 30 dB HL at 1, 2 and 4 kHz taken as significant hearing impairment. From 5528 students, 79 students (1.4%) found to have conductive hearing loss and 56 students (1.0%) had sensorineural hearing loss. A disabling hearing impairment was found in 0.9% of children. This shows a significant prevalence of hearing impairment in children in Zimbabwe (Brian D.W. *et al.*, 2005).

A total of 1307 primary school children surveyed in Kota Bharu and were found that the commonest cause of hearing loss was impacted wax being 5.81% (Elango S *et al*, 1991). Little P *et al* (1993) studied 15,845 subjects in general population of Nepal and found 16.6% had hearing impairment. However, the main cause of hearing impairment in the school age group is otitis media. Similarly, screening of 607 rural Pakistani children found the prevalence of hearing impairment is 7.9% with otitis media is the commonest cause (Elahi M.M *et al*, 1998).

1.7 Consequences of hearing loss

Hearing impairment in children usually results in the delay of the acquisition of speech and language skills. It constitutes a serious setback to optimal development and education. This will lead to poor learning and other problems at school age. As a result of their hearing loss, these children tend to exhibit negative behavior. They would appear as not paying attention, frequently interrupting others, or responding inappropriately to verbal direction or not responding at all. The mother would describe

their hearing impaired children as restless, disobedient, destructive, less well liked and less goal oriented.

The majority of hearing impairment is due to conductive hearing loss associated with disease of the external ear or middle ear. This condition once identified can be corrected. If these conditions are not identified or properly treated in children it may lead to adult life with hearing problems.

Hearing impairment in adult creates further difficulties. It prevents them from reaching their full economic potential. Furthermore, they may be subjected to social and emotional isolation. Having few friends and limited activity, they may experience isolation and clinical depression. Hearing loss is an invisible disability and as a result of this, hearing impaired adults may find themselves ignored, ridiculed or the target of anger from friends or strangers.

1.8 Screening

In implementing a screening programme, several factors should be considered. This should include practicality and the availability of resources including the facilities for rehabilitation. A screening tool that would be preferred should be reliable with good sensitivity and specificity, reasonably cheap, fast and user friendly. Hearing screening test proposed by ASHA (1997-2009) provide a cost effective and quick way to separate people into two groups: a pass group or fail group. Those who pass hearing screening are presumed to have normal hearing, while those who fail may have a probability of hearing loss and are in need of further evaluation by an audiologist and may need follow-up care from other professionals.

Most neonatal screening programmes are focused on infants who satisfy one or more of a number of criteria for inclusion into high risk register. Screening protocols based on certain high risk criteria may identify only 50% of all infants with congenital hearing loss and excludes the other 50% of infants with hearing loss. Those remaining children may not be identified until past the crucial time of communication skills development. The majority of these children, the parents are usually the first person to suspect that their child may have a hearing problem. Identification of hearing loss in infancy can result in normal language development if appropriate intervention is carried out by age of 6 months, regardless the degree of hearing loss (Arehart K.H.*et al,* 1999).

The JCIH has recommended that infants with significant hearing loss must be detected and identified by the age of 3 months old and intervention given by the age of 6 months old. The screening programme for infant was called Universal Neonatal Hearing Screening (UNHS), which grown greatly recently. In 1993, only in 11 hospitals in US screened more than 90% of their newborns. By 2005, every state had implemented this programme and data suggest that about 95% of newborns in the US are screened before discharge from the hospitals. Today, UNHS had been changed to Early Hearing Detection and Intervention (EHDI) programmes by all professionals groups which are involved in this programme (Katz J *et al*, 2009). Universal screening of neonates must be able to confirm both the type and degree of hearing loss in early infancy for it to be useful. It should be able to detect bilateral or unilateral, and sensory or conductive hearing loss, averaging 30 to 40 dB or more in frequency region important for speech recognition (approximately 500-4000 Hz). At this stage, screening may be relatively straightforward but the audiological diagnosis is not. The hearing screening involves use of non-invasive, objective physiologic measures that include OAEs and/or auditory

brainstem response (ABR). Both tests can be done painlessly while the infant is resting quietly.

In Malaysia, there is no universal school hearing screening programme being carried out in school-age children. Recently, efforts are being done nationally by the Ministry of Health to screen the hearing of newborn using otoacoustic emission (OAEs) test. There have been a number of different test methods attempted for infant hearing screening. For the past 22 years, the method of choice has been auditory brainstem response audiometry. It is preferred screening tool for neonates and infants. However its cost, technical difficulties and time requirement, have discouraged the general application of this method in screening. OAEs show some promise as a fast, cheap, non-invasive test of cochlear function.

OAE are sounds generated by normal cochlea hair cells and detectable with relatively simple instruments. OAEs testing uses sound to stimulate the cochlea of the inner ear. The ear itself then generates the very low intensity sound that matches the stimulus. The outer hair cells of the cochlea vibrate, and the vibration produces an inaudible sound that echoes back into the middle ear. This sound can be measured with a small probe inserted into the ear canal. A person with normal hearing will produce the emission while those with hearing loss greater than 25-30 dB will not. OAEs can detect blockage in the outer ear, middle ear fluids and damage to the outer hair cells in the cochlea. These cochlear emissions are recorded using sophisticated electronics and are used routinely in many nurseries to screen newborns for congenital hearing loss. OAE is divided into 2 types; spontaneous OAE (OAEs) and Evoked OAE (Transient Evoked OAE, TEOAE; Distortion Product OAE, DPOAE; and Stimulus Frequency OAE, SFOAE).

ABR is a test that measures nerve impulses in the brain stem resulting from sound signals in the ears. Electrodes are placed on the head, and brain wave activity in response to sound is recorded. ABR can detect damage to the cochlea, the auditory nerve and the auditory pathways in the brain stem. The information helps to determine what kind of signals the brain is receiving from the ears. Tests results are abnormal in people with some sensorineural types of hearing loss and in people with many types of brain tumours. Auditory brain stem response is used to test infants and can also be used to monitor certain brain function in people who are comatose or undergoing brain surgery.

Co-operative children and adults are usually tested using pure tone audiometry (PTA). This is a behavioural test. The person is required to wear headphones that play tones of different pitch and loudness. The person signals when he hears the tone by pressing the response button on the side that he hears the tone. For each pitch, the test identifies the quietest tone the person can hear in each ear. The results are presented in comparisons to what is considered normal hearing. Errors in the audiometrics results may be due to background noise in the test area, improper technique and unintentional or intentional misreporting by the subject. Preferably, audiometry should be done in sound treated booth or room. In our study we use sound level meter to measure surrounding noise before doing the test.

1.9 Intervention and Rehabilitation

Ear diseases causing hearing loss are relatively easy to treat. Diseases of the outer ear for example impacted wax, otitis externa, and diseases of the middle ear such as acute or chronic otitis media, secretory otitis media are common in both children and adults.

These diseases may be treated using drugs and/or aural toilet. Patient coming early would have their disease cured and their hearing restored. But only a very small proportion of those cases seen in ORL clinics can be treated by medical or surgical intervention. This is because the majority of hearing loss is cochlear origin and the established cochlear damage is usually irreversible. Irreversible damage may also result from physical trauma, viral infections, ototoxic drugs or noise.

In children, irreversible hearing impairment should be detected and rehabilitated early. Significant hearing loss has lead to important consequences for language acquisition, communication and cognitive, social and emotional development. For the optimum development of speech and language, the auditory pathway must be stimulated from a very early age to allow it and the higher centre to mature properly. A survey of 9 countries of the European Economic Community published by Martin in 1986 showed that 90% of the children were not yet diagnosed by their first birthday and as many as 50% were not detected until 3 years of age. Even after the diagnosis has been made, there was a delay in the provision of a hearing aid, with up to 60% waiting for 12 months or more. The study also showed that half of the children were unable to carry on a meaningful conversation with strangers (Martin J.D *et al*, 1986). These condition will carry on till they enter school age and the problem sometime remains undetected. The child may have learning difficulties, social isolation and poor academic achievement.

For reversible hearing impairment, early detection and intervention, preferably before entering school are the most important action that should be done in order to prevent deterioration in their academic performance. If treated early, the child may improve a lot. Ear disease may cause hearing impairment in both children and adults. Children and adolescents from lower family income experience a greater number of health problems

including ear disease and hearing problems. Much of added illness burden may result from their environment and limited access to health care. Similarly, behavioural and developmental problems has been shown to be more prevalent among children who live in environments where biological insults are more prevalent, basic nutrition questionable and where family relationships are less supportive and more volatile.

CHAPTER 2:

OBJECTIVES

2.0 OBJECTIVES

2.1 General

To study the prevalence of undetected hearing loss and ear diseases among standard six students in SKKK3

2.2 Specific

- To determine the treatable & non-treatable causes of undetected hearing loss among standard 6 students in SKKK3

- To determine the improvement of hearing level in early intervention and proper treatment for treatable causes of hearing loss

- To establish the association between undetected hearing loss and school performance

CHAPTER 3:

METHODOLOGY

3.0 METHODOLOGY

This is a cross-sectional study in which a total of 232 subjects were selected from all standard six students of SKKK3 in 2008. Academic achievement evaluation based on class streaming, UPSR results and Bahasa Malaysia results. Data can be also used to assess the prevalence of ear diseases in the study population.

3.1 Inclusion criteria

- Subjects who has undergone UPSR examination 2008
- Subjects not known to have severe hearing problem

3.2 Exclusion criteria

- Subjects diagnosed having ear diseases, hearing loss and/or learning problem
- Student with chronic illness

3.3 Sample size

Based on previous study, the latest by Noor R.M in Kuala Terengganu in 2006. The sample involves a total of 257 school children. In this study, an attempt was done to take all the standard 6 students in SKKK3 with a total number of 232 students. However only 193 fulfilled the inclusion criteria.

3.4 Materials

In this study, we use two part of research tool; Part 1 and Part 2.

3.4.1 Part 1 : Informed consent and Questionnaire

The informed consent was obtained using a standard form to assess respondent's self or caregiver's permission to include respondent into the study. The relevant questions used in a previous National Hearing Survey; '*Tinjauan Kebangsaan Masalah Telinga & Pendengaran'* questionnaire by Kementerian Kesihatan Malaysia was taken to fulfil the objective of the study. The questionnaire has three parts. The first part of the questionnaire is for parents, the second is for respondents and the third is for the tester/researcher. Part one and two require the parents and students to fill in about their demography, history of ear disease and observation. While part three, the researcher will fill in the results of the test, which is the results of screening test.

3.4.2 Part 2: Tests

Before screening test, otoscopic examination was done using Welch Allyn Otoscope. Then, the hearing screening test was perfomed using Denmark's Interacoustic Otoread Distortion Product Otoacoustic Emissions (DPOAE). If they fail these screening test, Pure Tone Audiometry (PTA) test was done using Twin Channel Amplaid A321 Audiometer with Amplaid (Italy) A321 transducer (supra aural earphone and bone vibrator) in a portable Sound Proof room (local made) with noise measurement below 40dBSPL (measured using Quest (USA) 2900 series of Sound Level Meter). Another