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Risk Factors of Hearing Impairment Among Infants and Toddlers in the Gaza Governorates: A Case Control Study

Randa Fawzi Radi

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Prepared By

Randa Fawzi Radi

Bachelor Degree of Medicine and Surgery, Al - Quds University- Palestine

Supervisor: Dr.Bassam Abu Hamad

PhD, Associate Professor- School of Public Health

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Prepared By: Randa Fawzi Radi
Registration No.: 21511504

Supervisor: Dr. Bassam Abu Hamad

Master thesis submitted and accepted. Date: / /

The names of signatures of the examining committee members are as follows:

1. Head of committee: Dr. Bassam Abu Hamad Signature…………….
2. Internal examiner: Dr. Yehia Abed Signature…………….
3. External examiner: Dr. Yousif Abu El Reesh Signature…………….

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Dedication

It was said that difficult roads lead to beautiful destinations. However, without the support of my beloved family and friends, I will never reach these destinations.

I dedicate this work to all young children of Palestine, who deserve the right in a better life...

I dedicate it to my family, who keeps supporting me as along my tough study years.

I dedicate it to my friends, who keep empowering me with exceptional ideas and solutions

I dedicate it to my respectful teachers, who have filled us with passion

I dedicate it to all those who believed in me....

Declaration

I certify that this thesis submitted for the degree of master is the result of my own research, except where otherwise acknowledged, and that this thesis or any of its parts has not been submitted for higher degree to any other university or institution.

Signed:

Randa Fawzi Radi

Date:4/8/2018

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و ما توفيقي إلا بالله

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Abstract

Hearing loss is not only a global common birth defect, but also it is the most isolating type of disabilities. The risk factors for developing congenital or early-onset hearing loss vary across countries. This study explores the risk factors of hearing impairment among children below three years old in Gaza governorates which might help in setting preventive strategies.

The design of this study is a case-control one. Data were collected through face to face interviews conducted at the households of both cases and controls. Cases have been operationalized as children who were diagnosed to have moderate, severe and profoundsensorineural hearing impairment within the first three years of their life, while controls are children who are screened and proven to be free from any hearing impairment. Both cases and controls were randomly selected through a systematic sampling approach from the screening lists of Atfaluna Society for Deaf Children. For each case, one control has been selected matched by age. The number of cases and controls was 169 for each group. Data were collected by 4 trained data collectors during the period November 2017 through January 2018. The Statistical Package of Social Sciences Program was used for data entry and analysis which included using descriptive and inferential analysis including Chi square, odds ratio, t test and logistic regression.

Findings show that more cases were residing in rural areas and camps, and among those receiving social assistance ($p<0.05$), however, because there is no national screening program available, one should be careful in interpreting this finding. Mother's unemployment was more prominent among cases (98.8%) compared to their controls' counterparts (93.5%) and the difference was statistically significant (p 0.025). Having a family history and consanguinity were more prominent among cases than controls and the variations among the two groups were statistically significant (p 0.001 for both). The presence of complications during pregnancy especially pregnancy induced hypertension and fever was more reported among mothers of cases than controls and the differences among the two groups were statistically significant (p 0.004 and 0.001, respectively). Mothers who used medications (other than supplementation) during pregnancy especially Aspirin were found to be at a higher risk to have children with hearing impairment than their counterparts who didn't use medications and the difference among the two groups was statistically significant (p 0.023). In addition, taking folic acid during the preconception period for three months and more was found to be a protective factor as mothers of controls had reported taking it (56.8%) much more than the cases (36.4%) and the difference between the two groups was statistically significant (p 0.007). Moreover, maternal exposure to trauma or imaging during pregnancy were found to be more prominent among mothers of cases than controls and variations among the two groups were statistically significant (p 0.004 & 0.004, respectively).

The study flags the importance of antenatal care as mothers of controls had received timely antenatal care more than their counterpart of cases and the difference among the two groups was statistically significant (p 0.002). Regarding environmental conditions, children who had been exposed to loud noise were at a greater risk of developing hearing impairment than their counterparts who didn't experience that and the difference among the two groups was statistically significant (p 0.01). With regard to the infant related factors, the study reveals that prematurity, low birth weight and admission to Neonatal Intensive Care Units were strongly associated with the development of hearing impairments as these were more reported among cases than controls with statistically significant differences (p 0.006, 0.000, and 0.002, respectively). Children born with congenital anomalies affecting mainly head and face, had 2.8 times the risk of developing hearing impairment than their counterparts without congenital anomaly (p 0.045, OR 2.814). The study confirms that children suffering from recurrent otitis media were at a greater risk of developing hearing impairment than their counterparts who didn't as these were more reported among cases than controls and the difference among the two groups was statistically significant (p 0.000). Similarly, the use of ototoxic medications was more reported among cases (10.1%) than controls (0.6%) and the difference was statistically significant (p 0.001). To ascertain how variables, interact, logistic regression analysis was done and it shows that the significant risk factors for hearing impairment are mother's unemployment, receiving social assistance, positive family history, consanguinity, inadequate iron supplementation during pregnancy, failure to use folic acid early in pregnancy, low birth weight, recurrent otitis media, late antenatal care, exposure to loud noise and residing near trash containers.

The study concluded that hearing impairment among children less than 3 years is attributed to a wide array of socioeconomic, health and environmental related vulnerabilities. It is important to establish a health promotion program particularly around combating consanguinity, prematurity prevention, timely and appropriate preconception and antenatal care, in addition to conducting universal screening for all children particularly those as risk as identified in this study.

ملخص الدراسة

يعتبر فقدان السمع من أكثر العيوب الخلقية شيوعا; كما يعتبر من أكثر الحالات المرضية الحسية والتي تعتبر من أهم أسباب الإعاقات المسببة للعزلة حتى في البلدان المتقدمة.

تختلف مسببات فقدان السمع الخلقية (منذ الولادة) أو فقدان السمع في مراحل مبكرة من بلد إلى آخر، هذه الدراسة هي دراسة استكشافية درست الحالات المرضية في وجود مجموعة ضابطة و ذلك لاكتشاف عوامل الخطر التي قد تسبب ضعف السمع بين الأطفال دون الثالثة من العمر في محافظات غزة.
الدراسة تم تطبيقها من خلال استبيانات منزلية . الاستبيان ذاتي التطوير ويشمل ستة مجالات : متغيرات اجتماعية - ديموغرافية ، وتاريخ عائلي ، وعوامل متعلقة بالأم ، وعوامل متعلقة بالجنين ومرحلة الطفولة ، والخدمات الصحية المقدمة والظروف البيئية.

الحالات المرضية هي الأطفال الذين تم تشخيصهم بأنهم يعانون من ضعف السمع الحسي العصبي المعتدل إلى الشديد في عمر 0-3 سنوات ، وتم اختيارهم عشوائياً من القائمة المتوفرة في جمعية أطفالنا للصم ، أما المجموعة الضابطة فهي تشمل الأطفال الذين تتراوح أعمارهم بين 0-3 سنوات الذين لا يعانون من ضعف السمع كما ثبت من خلال الفحص الذي أجرته. جمعية أطفالنا للصم.

لكل حالة ،تم اختيار عنصر ضابط واحد يتطابق مع العمر. كان عدد الحالات 169 متطابقًا مع العمر مع 169 عنصر ضابط. تم استخدام برنامج الحزمة الإحصائية للعلوم الاجتماعية (SPSS) لإدخال البيانات وتحليلها.
تظهر نتائج هذا البحث وجود فرق كبير بين الحالات والضوابط بالعوامل المتعلقة بالمتغيرات الاجتماعية الديموغرافية حيث كانت هناك حالات مصابة أكثر من الضوابط مقيمة في المناطق الريفية والمخيمات ، وتتلقى المزيد من المساعدة الاجتماعية (في وجود دلالة احصائية $p< 0.05$) ، في حين لم يكن تأثير ظروف السكن واضحا في هذا البحث.

ساهم تاريخ العائلة وزواج الأقارب في ازياد خطر ضعف السمع. وأظهرت المضاعفات أثناء الحمل علاقة إيجابية ، وهي ارتفاع ضغط الدم الناجم عن الحمل وارتفاع درجة الحرارة ($p< 0.05$) . كما تبين أن الأمهات اللواتي استخدمن الأدوية أثناء الحمل معرضات لخطر أكبر أن يكون لديهن أطفال ضعاف السمع. ومن المثير للاهتمام أن الأسبرين بشكل خاص أظهر وجود علاقة إيجابية مع ضعف السمع ($p< 0.05$). ووجد أن التعرض للإصابات أو التصوير خلال الحمل يرتبط بضعف السمع ، ولكن لم يتم العثور على ارتباط مع حدوث انفجار قريب. وقد وجد أن استخدام حمض الفوليك في فترة ما قبل الحمل لمدة ثلاثة أشهر وأكثر يرتبط ارتباطًا عكسيا بضعف السمع ، ويتم تطبيق نفس الشيء على الاستخدام المبكر لحمض الفوليك ومكملات الحديد أثناء الحمل ($p< 0.05$). وجد الباحث أن الخداج وانخفاض الوزن عند الولادة يرتبط ارتباطًا وثيقًا بضعف السمع عند الرضع والأطفال الصغار. عواقب الخداج مثل الدخول الى وحدة العناية المركزة لحديثي الولادة والتهوية الميكانيكية تؤثر أيضا إيجابيا على تطوير ضعف السمع ($p< 0.05$.)

اليرقان الذي يتطلب تغيير الدم للرضيع يزيد من خطر ضعف السمع عند الرضع والأطفال الصغار.
كما أن الأطفال الذين يولدون بعيوب خلقية في الرأس والوجه أكثر عرضة لخطر ضعف السمع.
وجد الباحث أنه إذا كان الطفل لديه تاريخ من التهاب الأذن الوسطى المتكرر ، فإنه سيكون أكثر عرضة لضعف السمع. وأظهر استخدام الأدوية السامة للأذن أيضا وجود علاقة إيجابية مع ضعف السمع P <0.05).

وفيما يتعلق بتوفير الخدمات الصحية ، فإن النساء اللواتي كان تلقوا رعاية طبية خلال فترة الحمل واللواتي سجلن في الأشهر الثلاثة الأولى من الحمل كانوا أقل أطفالهم عرضة لخطر الإصابة بأمراض السمع. كان الأطفال المعرضون للضوضاء الصاخبة المستمرة أكثر عرضة لضعف السمع، حتى الأطفال الذين تعرضوا لضوضاء عالية جداً لمرة واحدة كانوا أيضاً في خطر متزايد ($p< 0.05$)). لم يُكتشف أن التعرض البيئي للمواد الكيميائية يرتبط بضعف السمع. وينطبق الشيء نفسه على التدخين ، حيث فشل الباحث في العثور على ارتباط بين تعرض الأطفال للتدخين وضعف السمع. العلاقة بين حاويات القمامة القريبة وضعف السمع كانت بارزة ($p< 0.05$)). الأطفال الذين كانت منازلهم بالقرب من حاويات القمامة كانوا أكثر عرضة لضعف السمع ، من ناحية أخرى لا يمكن العثور على نفس العلاقة مع موقع الضخ القريب أو محطة البنزين.

خلصت الدراسة إلى أن ضعف السمع في الأطفال أقل من 3 سنوات هو نتاج تفاعل متعدد العوامل. يجب أن يتم التركيز على استهداف المجموعات المحفوفة بالمخاطر عن طريق فحص البرامج و التقصي في أسرع وقت ممكن في الأسابيع الأولى من الحياة في ظل غياب الفحص الشامل.

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List of Abbreviations

ABR	Auditory Brainstem Response
ANC	Antenatal Care
ASDC	Atfaluna Society for Deaf Children
CI	Confidence Interval
CMV	Cytomegalovirus
CWDs	Children with Disabilities
dB	Decibels
KHz	Kilohertz
LBW	Low Birth Weight
MRI	Magnetic Resonance Imaging
MOH	Ministry of Health
NA	Not Available
NECC	Near East Council of Churches
NICU	Neonatal Intensive Care Unit
NGOs	Non-Governmental Organizations
OAE	Otoacoustic emissions
OCHA	United Nations Office for the Coordination of Humanitarian Affairs in the occupied Palestinian territory
OR	Odds Ratio
PCBS	Palestinian Central Bureau of Statistics
PCC	Preconception care
PHC	Primary Health Care
PIH	Pregnancy Induced Hypertension
PNC	Postnatal Care
PNCTP	Palestinian National Cash Transfer Program
SNHL	Sensorineural Hearing Loss
SPH	School of Public Health
NIHL	Noise Induced Hearing Loss
UN	United Nations
UNFPA	United Nations Population Fund
UNRWA	United Nations Relief and Works Agency for the Refugees of Palestine in the Near East
USA	United States of America
WHO	World Health Organization

Introduction

1.1 Background

Hearing loss from birth up to the age of 3 years has a negative effect on speech, language development and results in sensory, cognitive, emotional, and academic defects in adulthood by causing delayed development of communicative-linguistic abilities(Shojaei, Jafari, & Gholami, 2016). Communication which is necessary for socialization and integration into the family and the society as well, is the most important loss in deafness(World Health Organization-WHO, 2017a).Children with Disabilities (CWDs) including those with hearing impairment, usually suffer not only from poor physical and psychosocial health, but also disabilities affect their education and learning potentials, quality of life, social participation and their future chances in all aspects(Breckell, 2015).Moreover, the stigma associated with disabilitiesaffectsnot only children but also their families, who tend to be isolated, frustrated and overwhelmed by the unmet needs of their CWDs.This comes on top of inadequacy of services provided to CWD (Jones et al, 2016). What complicates the suffering more is that the majority of people with disabling hearing loss live in low- and middle-income countries (WHO, 2017a).

The estimated incidence of permanent congenital or early onset hearing impairment in developing countries is high as in 2012 it was six cases per 1000 live births which is three times higher than in developed countries(Olusanya, Neumann, & Saunders, 2014). Over 5% of the world's population – 360 million people – has disabling hearing loss (328 million adults and 32 million children) (WHO, 2012a). In the past disabilities census done in 2012 in the Gaza Strip, there were 12,127 individuals with disabilities under 18 years old(Palestinian Central Bureau of Statistics-PCBS, 2013a). The report shows that 12,096 of them were interviewed and 1,432 of them mentioned that hearing impairment was the main disability they suffer from (PCBS, 2013a).

Although the priority must be given to the primary prevention of hearing impairment, especially in low- and middle-income countries, secondary and tertiary prevention via early detection and treatment of hearing impairment, especially in infants and young children, are still needed and should be actively encouraged(Olusanya, Neumann, & Saunders, 2014). Prevention and early detection depends on the availability of universal screening or at least targeting children and families with risk factors. Identification of risky groups would help in focusing efforts to raising awareness, health education and counselling, screening activities and psychosocial support. Although in many countries, there are several programs to identify those at risk for hearing impairment and to address them or even to target all children, in Palestine, this issue is still neglected and few ad hoc projects based activities are done(Abu Hamad, 2011). It could be argued that particularly health care providers and policy makers would benefit from studying risk factors in their estimation of future needs, required services and strategic planning for prevention and early detection services.

1.2 Statement of problem

As aforementioned, in general, and irrespective of the age at which it develops, disabling hearing impairment has devastating consequences for interpersonal communication, psychosocial well-being, quality of life and economic independence.The screening activity conducted by Atfaluna Society for Deaf Children (ASDC) in 2009 and 2010 among children less than 5 years old indicated that the prevalence rates of hearing loss range between 1.3 % to 1.7%(Abu Hamad, 2011) almost 17 times higher than the rate at United State of America(USA). Although many studies have been conducted on the prevalence of hearing impairment in Gaza, still risk factors for hearing impairment haven't been adequately studied, if any. The literature indicates that the etiology of congenital or early-onset hearing loss most likely varies from country to country (WHO, 2017b), therefore it is important to study the country specific risk factors in order to consider these factors in the prevention and screening programs.

There are information gaps related to the factors contributing to the development of hearing impairment. Possibly, socio-cultural, environmental and health related factors affect the development of hearing impairment in Gaza, therefore these were included in the study. This study attempts to fill such information gap by providing illuminations about the possible risk factors associated with hearing impairment which might help in developing corrective programs to control its occurrence and to program appropriate early interventions.

1.3 Justification

Hearing loss is not only the most common birth defect and the most prevalent sensorineural condition in developed countries, but also the most isolating disability (Hilgert, Smith, & Van Camp, 2009).The estimated incidence of permanent congenital or early onset hearing impairment in developing countries in 2012 was six cases per 1000 live births which is three times higher than in developed countries(Olusanya, Neumann, & Saunders, 2014).The etiology of congenital or early-onset hearing loss most likely varies from a country to country, and regardless of its cause, unidentified hearing loss at birth or during the first few years of life adversely affects speech and language development, as well as success in school and social-emotional development(Shojaei, Jafari, & Gholami, 2016). Although there are known risk factors related to perinatal and neonatal period, still context specific risk factors may pay a role like socioeconomic and environmental conditions, therefore this study is particularly important as it studies these worldly known risk factors in the Gazans context.

In the absence of universal hearing screening programs for neonates and infants, a significant number of children with hearing loss are not detected until well beyond the neonatal period(Christianson, Howson, & Modell, 2006).Prevention during pregnancy requires risk identification and management. There is minimal information about the risk factors of hearing impairment in Gaza Strip. The role of identification of risky groups is very essential and affect any intervention or screening program. Any future intervention or policy should take in consideration this role. This study aimed to fill the gap in this field as it the first research done to explore the risk factors of hearing impairment in the first three years of life.

The National Center for Hearing Assessment and Management in USA estimates that the detection and treatment at birth of hearing loss saves $400,000 per diagnosed child in special education costs and other opportunity costs; while, screening costs approximately $8-50/child (Haddad & Keesecker, 2016). In comparison to other preventive interventions and to commonly accepted cost-effectiveness benchmarks, newborn hearing screening is highly cost-effective(Abu Hamad, 2011).The result of this research could support the selection of risky groups if universal screening is not feasible, which could save costs and prevent long term suffering of children and their families

One of the outcomesof this study, is a report that shows an empirical evidence of the risk factors of hearing impairment. Groups at risk are identified and hopefully targeted via prevention and awareness, early screening and intervention programs. The formal and social media could be used to deliver key massages to the community to shed the light on the preventable risk factors of hearing impairment.Also,the results of this study will be disseminated to all relevant stakeholders. A dialogue could be initiated with policy makers to target identified risky groups. All primary healthcare providers such as Ministry of Health (MOH), United Nations Relief and Works Agency for the Refugees of Palestine in the Near East (UNRWA) and Non-Governmental organizations (NGOs) will be included to discuss the results and possible interventions and health massages that could be conveyed to people, first line health care providers could use the results of this research in paying further attention to cases at risk. Universities and public health institutions could be called for partnership and possible future co-operation and more advanced research in this field. As this study is the first one ever done in Gaza governorates which explores the possible risk factors for hearing impairment in children less than three years, it can be used as a foundation for more in-depth research.

Having that said, the study is beneficial to a wide sector of audiences including but not restricted to interested researchers, policy makers, practitioners, international development agencies and most importantly to the local community.

1.4 Aim of the study

The aim of the study is to explore risk factors of hearing impairment among children below three years old. The study is looking ultimately to provide health care providers with recommendations that might help in combating hearing impairment through identifying the risky groups and targeting them by prevention and screening programs thus contributing to reduction in morbidity and promotion of wellbeing of children and their caregivers.

1.5 Objectives of the study

- To identify infants and toddlerswho are more at risk of developing hearing impairment.
- To recognize variations in the development of hearing impairment in relation to socio-economic and cultural variables.
- To explore variations in the development of hearing impairment in relation to environmental variables.
- To ascertain variations in the development of hearing impairment in reference to health-related factors.

- To suggest possible recommendations todecrease hearing impairment.

1.6 Research questions

1. What is the relationship between sociodemographic variables and hearing impairment in infant and toddlers?
2. What is the effect of education level of parents and economical status on the development of hearing impairment?
3. Do housing conditions affect the development of hearing impairment in infants and toddlers?
4. What is the role of consanguinity and family history of hearing impairment in the development of hearing impairment in infants and toddlers?
5. What is the relationship between maternal chronic diseases, complications and hearing impairment development?
6. Does medication usage and exposure to imaging during pregnancy affect the development of hearing impairment?
7. Do maternal events such as trauma affect the development of hearing impairment?
8. What is the relationship between gestational age, birth weight and hearing impairment?
9. Does admission to neonatal intensive care unit, mechanical ventilation and neonatal jaundice increase the risk of hearing impairment?
10. Does the health care service provision to the mother particularly preconception and antenatal care make a difference in the development of disability?
11. What is the relationship between high noise and hearing impairment in infants and children?
12. Do environmental conditions affect the risk of hearing impairment?

1.7 Context of study

1.7.1 Geographical and demographical context

The Gaza Strip,365 km, a coastline of 40 km, with a total population of 1,899,291 (PCBS, 2018a). The high density(5203 per Km2) of population has many social and service provision implications.The Gaza Strip is divided into five governorates: North Gaza, Gaza City, Mid Zone, Khnunis and Rafah. The number of new born in 2015 was 54442(PCBS, 2017). Such a high number of new born is a big challenge for any health care system given the current limited capacity of the local health system in Gaza. The percentage of children aged 0-14 is more than 42.6% which increases the burden on the health system, the neediest at age of 0 up to 5 constituteabout 16.7% of all population (PCBS, 2017)

The high density of population is accompanied by high proportion of children under 15 years old in the scarceness of all resources, stress the health system and increase the demand of targeting vulnerable groups such as children with hearing impairment.

1.7.2 Socioeconomic context

The Palestinian population has one of the highest fertility rates in the region, the mean number of children ever born to ever married Palestinian women (15 Years and over) equals to 4.5 in Gaza Governorates (PCBS, 2018a). Religious and cultural beliefs dominating the society encourage fertility and having many children. Having many children provides a type of social security and protection for the family and the tribe against others(Courbage, Abu Hamad, & Zagha, 2016).

Consanguineous marriages which have been practiced throughout history continue to be practiced. Currently there is a decrease in the overall prevalence of consanguineous (first- and second-cousin) marriages between the previous (fathers') generation (45.2%) and the current (groom/bride) generation (39.9%), among the five governorates of the Gaza Strip, records of Gaza Governorate revealed the lowest occurrence of this phenomenon (Sirdah, 2014). In another report, the percentage of women (aged 15-49) married to first-degree relatives was 30.1% in the Gaza Strip (PCBS, 2012).Regarding the age at marriage, more than 50% of female aged more than 15 are married, 36% of married women have been married before the age of 18 years and 5% married before the age of 15 years (PCBS, 2013b). The current median age of marriage of females in Gaza is 19years (PCBS, 2018a)

The capacity of the Palestinian economy to cope with the size of the population and age structure, taking into consideration a high fertility rate, rapid population growth, and ayoung population, is governed largely by its labor market and employment.The Palestinian economy is highly manipulated by “Israel”. Youth unemployment is high, averaging 33.6% for Palestine during 1991-2014 with a minimum of 17.4% in 1999 and a maximum of 41.7% in 2002, and remained high 37.5% during 2005-2013which frustrates youth, and when prolonged, it opens the door to negative behaviors including crime, drugs, and violence in the family besides the lost opportunities for productivity(Courbage, Abu Hamad, & Zagha, 2016).The unemployment rate at the third quarter of 2017 was 46.6%, while among youth it stood at 64.9% and 71% among women (United Nations Office for the Coordination of Humanitarian Affairs in the occupied Palestinian territory-OCHA, 2017a).Poverty among individuals in the Gaza Strip was 38.8% in 2011 while it jumped to 53.0% in 2017 with 37% increase,deep poverty percentages also increased significantly in theGaza Strip, as the deep poverty percentage was 21.1% in 2011 and became 33.8% in 2017 with an increase by around 60% (PCBS, 2018b). Poverty and disability seem to be inextricably linked. It is often noted that disabled people are poorer, as a group, than the general population, and that people living in poverty are more likely than others to be disabled(Elwan, 2001).People living in poverty often go hungry and have limited access to safe drinking water, adequate sanitation or healthcare services. They are more likely to live in dangerous environments with low quality housing, in areas prone to natural disaster, dangerous traffic and/or higher rates of conflict. People living in poverty are also more likely to undertake high-risk work. All these conditions of poverty significantly increase someone’s chances of being disabled by malnutrition, disease or injury(Action on Disability and Development International, 2012). More than half of the households in Gaza are either food insecure (44%) or vulnerable to food insecurity (16%) (United Nation-UN, 2012) due primarily to a lack of economic means, rather than a shortage of food in the local market.

1.7.3 Environmental context

Fundamental infrastructure in electricity, water and sanitation, municipal and social services, is struggling to keep pace with the needs of the growing population in Gaza. The limited operation of water pumps and water desalination plants has led to a decline in water consumption and hygiene standards, this results into water consumption in the Gaza

Strip below the WHO-suggested service delivery level of 100 L per capita per day. The shortening or suspension of sewage treatment cycles has led to the increased pollution of the sea along the Gaza and southern Israel coast (OCHA, 2017a). Inaddition,the aquifer is contaminated by nitrates from uncontrolled sewage, and fertilizers from irrigation of farmlands(Manenti et al, 2016). Many experts believe that the groundwater in some areas of the Gaza Strip is contaminated of heavy metals as a result of recurrent wars, they also believe that women are more vulnerable to war induced changes in water quality(Safi, 2015).At the end it is estimated that 97% of piped water is unfit for human consumption (OCHA, 2017a).

Solid waste management in Gaza Strip is a matter of grave concern and it is one of the most serious challenges confronting the local authorities because of high volumes of solid waste generation and economical and political restriction by Israel. Due to the limited access to the three overloaded central dump sites a substantial part of the waste is dumped temporally at transfer sites throughout Gaza without control or protection(Nassar, 2015). The current situation with regard to handling of waste in the Gaza Strip poses serious threats to the environment and public health. One major threat relates to mixing of hazardous and untreated health care waste with the main stream domestic solid waste(German Federal Ministry for Economic Cooperation, 2014). Both waste collectors as well as the general public are directly exposed to these threats, specifically near public containers along the streets where the waste is mixed and near dump sites (Nassar, 2015).

Gaza was exposed to three Israeli aggressions in the last few years.While these aggressions had affected all aspects of life in the Gaza Strip, and exacerbated the already painful conditions of the people of the Gaza Strip, it must have caused serious damages to the environment. In these aggressions tons of weapons, explosives and toxic gases were bombarded onto the Gaza Strip especially on the Eastern side(Safi, 2015). Over 18,000 homes were destroyed or severely damaged during the 2014 conflict, displacing 100,000, of whom about 20,300 remain displaced as of November 2017, leaving millions of tons of rubble polluting the air with particulate matters and dust and potentially causing other types of nuisance through hosting rodents and insects (OCHA, 2017a). Heavy machinery, tanks, and artillery invaded almost the Eastern belt of the Gaza Strip causing damages to the top soil, both mechanical and chemical(Safi, 2015).During these aggressions, many people were exposed to white phosphorus, which correlated significantly with the occurrence of birth defect (Naim et al, 2012).All these changes in environment with recurrent damaging events need to be studied and correlated with the risk of hearing impairment.

1.7.4 Health care system

There are four major health service providers in Palestine: the MOH, UNRWA, NGOs, and private for-profit providers. MOH provides primary, secondary and tertiary health services and purchase the unavailable tertiary health services from domestic and abroad providers. UNRWA provides primary care services, only for refugee and purchase some secondary care services. NGOs provide primary, secondary and some tertiary services. Private for-profit sector provides the three level of care through a variety of specialized hospitals and investigation centers(Regional Health Systems Observatory- EMRO, 2016).

In Gaza hospitals, electricity shortages and the lack of drugs and medical disposables are life threatening, particularly for non-communicable disease and emergency patients. Electricity shortages are directly affecting the 14 hospitals, and more than 140 Primary Health Care(PHC) clinics (49 MOH, 22 UNRWA and 66 NGO PHC facilities), and disrupting critical services such as blood banks, laboratory, and vaccine storage (OCHA, 2017b).

An estimated 10,000 newborn infants out of 55,000 born every year are acutely vulnerable and in need of transfer to nursery and neonatal units for specialized life-saving treatment. These specialized units face shortages, such as incubators, ventilators, medical supplies of drugs and disposables, and lack of staff; all of these risk factors place the 10,000 newborns at risk and contribute to the stagnant neonatal mortality rate, which is currently at 14 per 1,000(MOH, 2016).

Access to healthcare services for women including maternal and reproductive healthcare, is also negatively impacted by specific contextual challenges. In Gaza, the Health Cluster estimates that 150,000 women out of 500,000 women in need of reproductive health services are acutely vulnerable(OCHA, 2017b). Out of the 150,000 acutely vulnerable women, 80,000 need support to prevent high risk pregnancies and 70,000 women need preconception care. Challenges include significant shortages in equipment and trained medical staff, a lack of awareness of preconception health and reproductive health, and low rates of exclusive breastfeeding (OCHA, 2017b).It should be mentioned that high antenatal care coverage in the country is reaching 99.5 percent with at least four visits per pregnancy, compared with relatively low coverage with post-natal care poses health and human right issue and forms an area for improvement. Integrity, harmonization and quality of reproductive health services in general remain the major concern at the national level and for all healthcare providers (United Nations Population Fund-UNFPA, 2017).

The key services for CWDsprovided at the national level are health and education, with some social protection support through the Palestinian National Cash Transfer Programand health insurance for those with disabilities (Jones et al, 2016). Most of the other needed services are supposed to be delivered at the intermediary and local levels, though not all are delivered as they should.Health and rehabilitation servicesfor CWDs, like the health services provided to the broader population, are provided by different stakeholders. While MOH is legally mandated to provide health services to all citizens—including CWDs—and UNWRA provides services to the refugee population, the basic package of available services is not adequately tailored to address the specific health care needs of those with disabilities including hearing impairment, particularly the youngest children. Early diagnosis and intervention, which are crucial to supporting positive developmental trajectories, are absent or of low quality (Jones et al, 2016).

NGOs play major role in diagnosis, rehabilitation and management of children with hearing Impairment.Among the main organizations which offer services related to hearing impairment, ASDC, Al Amal Rehabilitation Society –Rafah, Deir Al Balah for Rehabilitation and Jabalia Rehabilitation Society offer diagnosis, education services and assistive devices. ASDC is a registered Palestinian NGO located in Gaza city, has been working in the field of deaf education and allied services since 1992.ASDC is working extensively to contribute towards meeting the needs of persons with hearing impairments. Thousands of deaf children and adults and their families are served annually at ASDC premises through deaf education, audiology clinic, speech therapy, income generating programs for the deaf, vocational training and many others.ASDC is the only all-service center for the deaf in Gaza–classrooms, treatment center, shop and restaurant. ASDC is the only organization that performs the Auditory Brainstem Responses (ABR) to confirm the diagnosis of hearing loss. During 2015, 373 children were diagnosed with varying types and degrees of hearing loss and 167 deaf and hard of hearing children aged between 0 and 5 years received early intervention services including communicative, cognitive, and social skills (ASDC, 2015).

1.8 Operational definition

1.8.1 Hearing impairment in infant and toddlers

Hearing loss presents at birth or early onset hearing loss in the first three years of life. Operationally in this study the childis identified as having hearing impairment if he/she had been diagnosed at ASDCas having hearing impairment before his/her3rd birthday as evidence by ABR results.

1.8.2 Cases

Cases are operationally defined as children, below three years at the time of diagnosis, who are confirmed to suffer from hearing impairment as evident by ABR results and registered at ASDC during the last four years (Jan 2014 through July 2017).

1.8.3 Controls

Controls are operationally defined as children aged 0-3 who are free from hearing impairment,tested and proven to be free by ASDC during the last four years (Jan 2014 through July 2017).

1.8.4 Toddlers

Children aged from 12 to 36 months.

Literature review

2.1 Conceptual framework

According to the literature, hearing impairment is a product of multiple connected and interactive factors.Following are some of the factors that can increase the chance that a child will have hearing loss that have been recognized by the literature which were put under investigations in this study:

2.1.1 Socioeconomic factors

These are the factors related to social and economic conditions of the family and includes sociodemographic data related to family size and type, parents' ages and education, and early marriage. This part also includes economic variables like family income, expenditure and social assistance. Also housing conditions in terms of dwelling type and water sources are explored as these were found to relevant in others context.

2.1.2 Family history

Some infants with a genetic cause for their hearing loss might have family members who also have a hearing loss (Center for Disease Control and Prevention-CDC, 2015b). Intra-familial marriages could increase the risk of hearing impairment or related congenital abnormalities therefore these were included in this study.

2.1.3 Maternal factors:

Maternal factors are related to mother health conditions and diseases and might play a role in the development of hearing impairment as evident in other studies. These include, preconception period where counselling and folic acid supplement are important, maternal history during pregnancy in terms of chronic diseases like hypertension, diabetes and asthma, complication during pregnancy like pregnancy induced hypertension, gestational diabetes and infections, maternal exposure to trauma, imaging, explosion and smoking, and maternal use of medications and supplements during pregnancy.

2.1.4 Fetal factors

Fetal factors are related to infant conditions and complications during and after birth, the international literature indicates that many fetal conditions and complications are contributing to the development of hearing impairment such as: complication during delivery and lack of oxygen, prematurity and its sequences like Low Birth Weight (LBW), admission to Neonatal Intensive Care Unit (NICU) and mechanical ventilation, neonatal and childhood diseases like jaundice, meningitis and recurrent otitis media, associated abnormalities of face and ear, use of ototoxic medication and exposure to trauma.

2.1.5 Health services provision

The literature indicates that appropriate care related to pregnancy are important factors in developing hearing impairment. The researcher included factors related to the availability, utilization and barriers to available health services by mother and her infant. The study focuses on assessing the effect of receiving timely and appropriate the Preconception care (PCC), Antenatal care (ANC), safe delivery, Postnatal care (PNC), neonatal care and vaccination.

2.1.6 Environmental conditions

These are the factors related to the surrounding environment and exposures and include exposures to continuous loud noise, chemicals like insecticides, pesticides and detergent, smoking, asbestoses, nearby factories, pumping sites, trash containers and petrol station.

The following figure shows the factors that were studied in this research

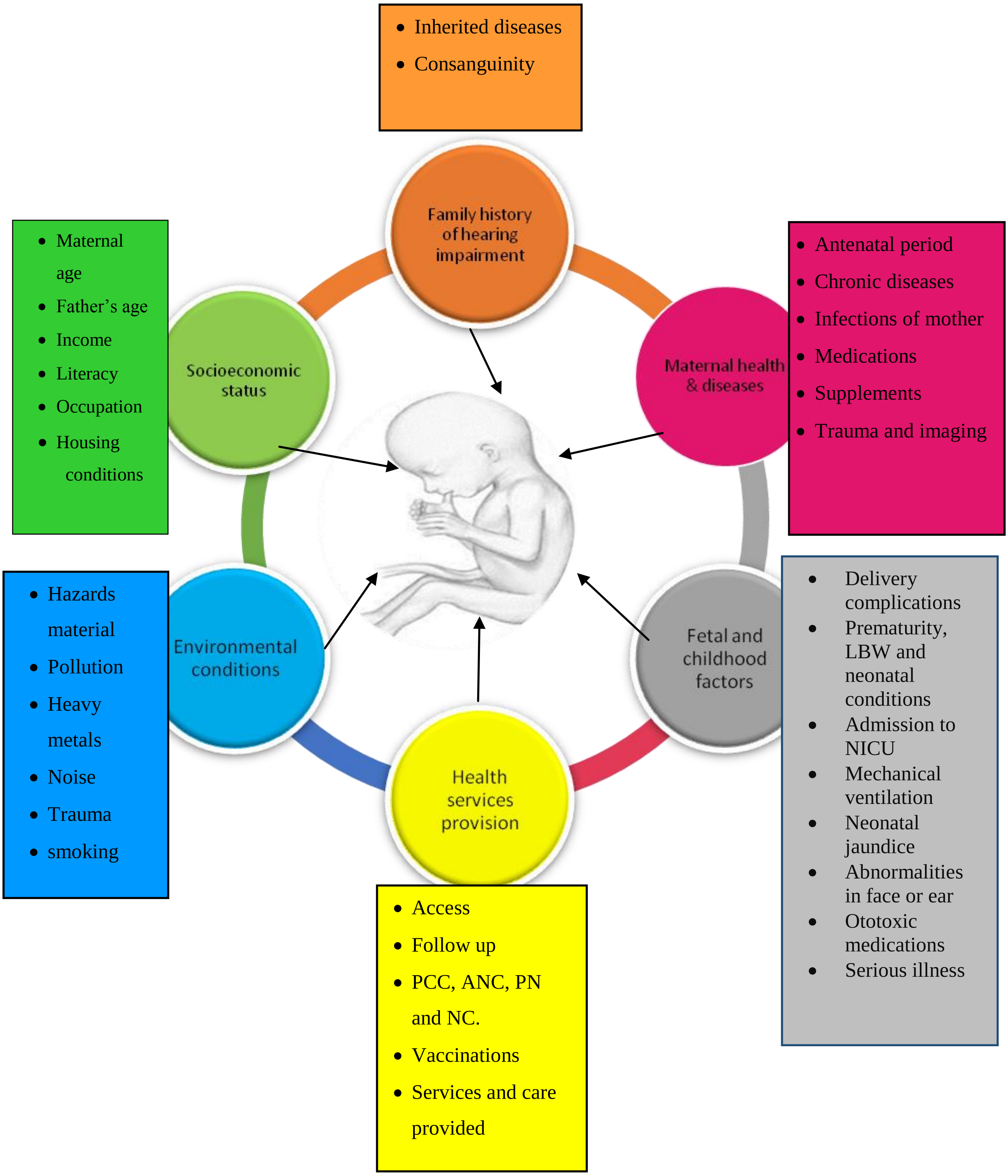

Figure 1: Frame work

2.2 Literature review

2.2.1 Definition of hearing impairment

Hearing is the ability to perceive sounds. Sound occurs over a wide spectrum of frequencies. The human ear is sensitive to a frequency band within that spectrum expressed in decibels (dB). Frequencies capable of being heard by humans are called audio or sonic. The range is typically considered to be between 20 Hz and 20,000 Hz (Hertz). Frequencies higher than audio are referred to as ultrasonic, while frequencies below audio are referred to as infrasonic. Loss of the ability to hear sound frequencies in the normal range of hearing is called hearing impairment (Mathers et al, 2002). The term hearing loss or impairment is used tocover all kinds of deafness. There are four different levels of hearing loss, defined by the quietest sound that you are able to hear, measured in decibels (dB), mild, moderate, severe and profound.Bilateral neural hearing loss is categorized as mild (20-30 dB), moderate (30-50 dB), severe (50-70 dB),orprofound (>70 dB)(Haddad & Keesecker, 2016). The WHO defines disabling hearing impairment in adults as a permanent unaided hearing threshold level (average for frequencies 0.5, 1, 2, 4 kHz (kiloHertz)) for the better ear of 41 dB or greater. In children under 15 years of age, disabling hearing impairment is defined as permanent unaided hearing threshold level (average for frequencies 0.5, 1, 2, 4 kHz) for the better ear of 31 dB or greater(Duthey, 2013). The WHO classified hearing impairment into five grades, slight, moderate, severe and profound as shown in annex 3(Shield, 2006).

The three main types of hearing loss describe the underlying cause of the hearing loss and include sensorineural hearing loss, conductive hearing loss and mixed hearingloss. Conductive hearing loss indicates an obstruction to the flow of sound energy from the atmosphere to the inner ear. Pathology causing conductive hearing loss blocks the natural transduction of energy through the external ear canal and middle ear. While sensorineural hearing loss is a broad term used to describe reduction of auditory threshold sensitivity. The pathology may be located in the cochlea and/or in the auditory nerve and central nervous system auditory structures(Swanepoel & Laurent, 2017)

2.2.2 Epidemiologyof hearing impairment.

Hearing loss is more prevalent than diabetes mellitus, myelomeningocele, all pediatric cancers, and numerous other medical conditions(Shah, 2017). WHO estimates that there are 360 million persons in the world with disabling hearing loss (5.3% of the world’s population), of which 32 (9%) millions of these are children (WHO, 2012a). It’s estimated that, 3% of hearing loss occurs in North Africa and Middle East. Approximately 141 million live births occurred in the world in 2012 and most of them – about 127 million – occurred in developing countries(Olusanya, Neumann, & Saunders, 2014). The estimated incidence of permanent congenital or early onset hearing impairment in developing countries in 2012 – six cases per 1000 live births – was three times higher than in developed countries (Olusanya, Neumann, & Saunders, 2014).

Hearing loss is unequally distributed across the world. Population based studies are rare particularly in developing countries where newborns and children are not systematically screened for hearing impairment(Duthey, 2013).In a systemic review published in 2012, final analysis dataset, they included 42 studies carried out between 1973 and 2010 in 29 countries, 18 studies were in high-income countries and 24 in low or middle-income countries and 13 studies only considered children and adolescents under age 20. Their results suggest that adult-onset hearing impairment has substantially higher prevalence in low- and middle-income countries than in high-income countries, demonstrating the need for attention to hearing impairment globally.After adjusting for differences in age structure, the prevalence of hearing impairment was highest in developing regions and lowest in high-income regions.The global prevalence of hearing impairment ≥35 dB HL among children under 15 years of age was 1.2% (95% uncertainty interval 0.8%-1.8%)(Davis, Smith, & Hoffman, 2012).The same data were used in another systemic review and showed that hearing impairment was positively related to age, male sex and middle- and low-income regions. The study estimated that the global prevalence of hearing impairment (defined as an average hearing level of 35 decibels or more in the better ear) in 2008 was 1.4% (95% uncertainty interval 1.0–2.2%) for children aged 5–14 years, 9.8% (7.7–13.2%) for females >15 years of age and 12.2% (9.7–16.2%) for males >15 years of age (Stevens et at, 2013).

Hearing loss occurs in approximately 5-10 per 1000 children in the United States. Roughly 1-3 in 1000 children are born with profound hearing loss, and 3-5 in 1000 are born with mild-to-moderate hearing loss that may affect language acquisition unless hearing, language, or both are aided. The prevalence of hearing loss requiring intervention among graduates from NICUs is 1-4%. Acquired hearing loss in children may add another 10-20% to these numbers(Shah, 2017).

South and East Asia and sub-Saharan Africa remain the world regions with the highest prevalence of hearing impairment in both adults and children. This can be explained by the high rates of pre- and post-natal childhood infections such as chronic otitis media, meningitis, rubella, measles, use of ototoxic drugs and excessive noise(Duthey, 2013). Some troubling statistics about the prevalence of hearing loss in the Middle East have emerged. It was found that roughly 8 in 1000 Egyptian children are born with a hearing loss, compared to only 1 in 1000 in the rest of the world (Hughes, Abdalla, & Irani, 2014).

Although the rates of the different types of disabilities are not precisely known in Gaza, there is a consensus that it is high. The screening activity conducted by ASDC in 2009 and 2010 among children less than 5 years old indicated that the prevalence rates of hearing loss range between 1.3 % to 1.7%. Siege, poverty, noisy environment, bombardments and explosions resulted from the political conflict, recurrent infections, miss-use of antibiotics, intra-familial marriages, lack of awareness and low education level are among the recognized risk factors for the development of hearing disabilities(Abu Hamad, 2011). In the past disabilities census done in 2012 in the Gaza Strip, there were 12,127 individuals with disabilities under 18 years old, 1,432 of them mentioned that hearing impairment was the main disability they suffer from, while the total number of children below 18 years who suffered from hearing impairment was 2,233 (PCBS, 2013a). In 2014, the prevalence of hearing impairment in children below 18 years was found to be 1 per 1000 (MOH, 2015)

2.2.3 Burden of hearing loss

One of the main impacts of hearing loss is on the individual’s ability to communicate with others. Spoken language development is often delayed in children with unaddressed hearing loss. Exclusion from communication can have a significant impact on everyday life, causing feelings of loneliness, isolation, and frustration (WHO, 2017a). Research shows that hearing loss doubles the risk of developing depression and increases the risk of anxiety and other mental health problems(Ming Li, Zhang, & Hoffman, 2014). There is now strong evidence that mild hearing loss doubles the risk of developing dementia – with moderate hearing loss leading to three times the risk, and severe hearing loss five times the risk (Thomson et al, 2017).There is also evidence that hearing loss is linked to learning disabilities, cardiovascular disease, diabetes, stroke and obesity(Breckell, 2015).In adulthood, people with hearing impairment can suffer from embarrassment, loneliness, social isolation and stigmatization, prejudice, abuse, psychiatric disturbance, depression, difficulties in relationships with partners and children, restricted career choices, occupational stress and relatively low earnings (Olusanya, Neumann, & Saunders, 2014). Stigma relating to hearing loss is both real and perceived. For many people, hearing loss and hearing aids are still associated with negative stereotypes, and fear of stigma itself can be strong, making people with hearing loss less likely to talk to others about their hearing loss and less likely to seek help(Breckell, 2015). In one research conducted in West bank and Gaza strip, the stigma surrounding disability in Palestine was both pervasive and strong (Jones et al, 2016). Outside of the home and sometimes even within it CWDs including those with hearing impairment tend to encounter very little actual support and even they are exposed to hostility and abuse. Over a third of children in our quantitative research reported that they avoided doing things simply because they could not bear the attitudes of those in the community and only 5% said they could always rely on their friends (Jones et al, 2016).

A WHO report was prepared by reviewing 450 studies over the period 2015-2016. These were studies and reports focused on costs associated with not taking action for hearing loss. The report showed that thecost of unaddressedhearing impairment to the health-care sector, for adults and children, is estimated to be in the range $67–107 billion (WHO, 2017b), this does not include the cost ofproviding hearing devices such as hearing aids and cochlear implants. A conservative estimate of the cost to the education sector of providing support to children (5–14 years) with unaddressed hearing loss is $3.9 billion. This assumes that only children with at least moderately severe hearing loss (hearing level greater than 50 dB in the better-hearing ear) require educational support (WHO, 2017b).The same report reveals that between 63% and 73% of the global costs to health and education sectors are incurred in low- and middle-income countries. Loss of productivity, due to unemployment and premature retirement among people with hearing loss, is estimated to cost $105 billion annually where societal costs – the result of social isolation, communication difficulties and stigma – add a further $573 billion each year. These costs are calculated on the basis of the monetary value attached to avoidance of a year lived with disability and draw upon disability-adjusted life years attributed to hearing loss (WHO, 2017b).An in-depth study in the United States estimates the societal costs of severe to profound hearing loss in the US to be $297,000 per person during that person's life. According to the study, the largest part of societal costs is a consequence of lost work productivity which is estimated to represent 67 per cent of total costs. Special education for children and young people amount to 21 per cent of societal costs in connection with hearing loss (Mohr, Feldman, & Dunbar, 2000). The same study reveals that cost per person is closely related to the age of the individual hearing-impaired person. The earlier a person is diagnosed with hearing loss the more expensive it will be for society. Thus, children and young people with hearing loss represent very large societal costs with an expected cost of nearly $920,000 over the lifetime per individual. Where hearing loss is found in young children before they start speaking, costs are estimated to amount to around $1,000,000, and this age group is thus the most expensive to society. On the other side, it was estimated that. The cost per each detected child in Gaza is $ 5953, if the capital costs on equipment were excluded it would drop to $ 4827(Abu Hamad, 2011). The difference in cost is possibly reflect the availability and cost of health services and environmental modifications, it could be also due to different living level.

In developing countries, children with hearing loss and deafness rarely receive any schooling.When identification and intervention occur during the first few months of life, infants and young children with hearing loss perform dramatically better on school-related measures such as vocabulary development, articulation, social adjustment and behavior (WHO, 2010).In Palestine, 15.2% of individuals with hearing disabilities required adaptations to transportation to continue their education, 12.5% required adaptations to school buildings, 24.2% required adaptations to classrooms and 3.1% required adaptations to toilet facilities (PCBS, 2013a).

2.2.4 Screening of hearing impairment in children

A hearing impairment of a disabling degree affects language development and education in children; it has social and employment implications for older individuals. There is an economic impact upon society as a whole. Hearing screening programs are undertaken to identify hearing loss and thereby enable active intervention to provide children with access to sound. Timing of the screen has been tried at two points: newborn and school entry. Several countries now have both newborn hearing screening programs (WHO, 2010). The longer a hearing loss remains undetected the greater the adverse effects can be (Newton, 2008). For children who have a hearing loss of congenital or perinatal causation, the earlier the habilitation process can commence the greater the benefit in terms of language development. The benefit is particularly pronounced if effective habilitation is introduced in the first six months of life (CDC, 2015b). The introduction of newborn-hearing screening has enabled early childhood hearing loss to be diagnosed and increased the number of children undergoing early care. Children with perinatal risk factors tend to have deteriorated hearing or delayed-onset hearing loss in early childhood, necessitating audiometric follow-up. There are some children without risk factors who develop hearing impairment during infancy or early childhood (Kataoka et al, 2011). Several national committees, including the National Institutes of Health, the American Academy of Otolaryngology/Head and Neck Surgery, and the American Academy of Pediatrics, have recommended that hearing loss in infants be identified, and when possible treated, prior to 6 months of age. This recommendation is based on studies that have shown that children identified with hearing loss prior to 6 months of age have a better chance of developing skills equivalent to their peers by the time they enter kindergarten (Mersch & Kibby, 2016).Whereas, at one time, screening of hearing in infants could not be carried untilold enough (7-8 months), the discovery of otoacoustic emissions and the development of equipment for screening with transient or distortion product otoacoustic emissions, has facilitated hearing screening in newborns. Otoacoustic emissions (OAE) and ABR, manually operated or automatic, are now used regularly in newborn hearing screening programs. Many programs use a two-stage protocol with OAEs used at the initial stage and ABR tests at the second stage; others use both tests initially to avoid missing the small proportion of infants with an auditory neuropathy (Newton, 2008).All children who do not pass a hearing screening should have a full hearing test (CDC, 2015b).

As newborn hearing screening programs have become established the age of diagnosis of hearing loss present from birth and subsequent hearing aid fitting has decreased. In the UK there are approximately 900 children born each year with significant, permanent hearing impairment likely to affect their own and their family's quality of life. Prior to the introduction of newborn hearing screening about 400 of these children would have been missed by the age of 1½ years, and about 200 by the age of 3½ years. The median age of confirmation of permanent bilateral moderate to profound hearing loss was 18.1 months and hearing aid fitting was 23.6 months. For the 2012/13 birth cohort this had reduced to 49 days and 82 days, respectively (Zhelev et al, 2015). In U.S.A, prior to the universal screening, the average age at which children were found to have a hearing loss is 2-3 years, children with mild-to-moderate hearing loss were often not identified until 4 years of age (Delaney, 2016).

In Gaza ASDC one of the main organizations conducting hearing screening for children less than 5 years in co-ordination with MOH, UNRWA and other NGOs. The screening is two step approach, initially children are examined by otoscope, tympanogram and OAE. If the child fails in the initial screening, he or she will have ABR to confirm the diagnosis and evaluate the grade of hearing impairment or loss.

2.2.5 Risk factorsof hearing impairment in children

Worldwide, although approximately 50% of all congenital anomalies including hearing loss cannot be linked to a specific cause, there are some known genetic, environmental and other reasons or risk factors. Social, cultural, environmental and health related factors play a role in the development of congenital anomalies (WHO, 2016a). More than half of all cases of pre-lingual deafness are genetic. Most cases of genetic hearing loss are autosomal recessive and non-syndromic(Antonio, 2016).In about 25% of cases of hearing loss there is a non-genetic cause that can be identified.

2.2.5.1 Socioeconomic factors

It is estimated that about 94% of severe congenital anomalies occur in low- and middle-income countries (WHO, 2016a). In children, the prevalence of hearing loss, decreases exponentially as gross national income per capita increases and decreases linearly as parent's literacy rate increases (WHO, 2012a). A large systemic review shows that Low-income families had a statistically significant increased prevalence of high frequency hearing loss as compared with children of families with high income. The same systemic review shows that there is a relation between hearing loss in children and occupation of head of household and demonstrated that lower classes had a significantly higher risk of births with sensorineural hearing loss, particularly among families of manual workers (Vasconcellos et al, 2014).

One research studied children born in Greater Glasgow,1985-94, with bilateral congenital hearing impairment.The children were divided into seven deprivation categories. One hundredand twenty-four hearing-impaired children were born over the study period, an incidence of 1.18/1000 livebirths. There was a clear association between deprivation category and incidence, ranging from 0.47/1000 to1.72/1000. An association with deprivation was seen for children with a family history and perinatal problems (such as prematurity and low birth weight) (Kubba, Macandie, & Macfarlane, 2009).

Cross-sectional analysis of stacked data from the 1997 to 2003 National Health Interview Survey, a total sample consisted of 76,012 children, of whom 2.6% had some hearing loss and 0.43% had marked hearing loss were interviewed. The survey showed that families of hearing-impaired children were more likely to report poorer health status, live in single-mother households, and live below the poverty level ($P < .01$). The survey concluded that, compared with families of children without hearing loss, families of hearing-impaired children live closer to the poverty level and utilize some medical services with less frequency (Boss et al, 2011).

The type of locality with its environmental and social aspects was found to be related to hearing impairment in children. In one survey conducted in China, A total of 616,940 children aged 0–17 years were investigated in this survey.There were 1112 children with hearing impairment identified in this survey Chinese children living in rural areas were more affected than those living in urban areas (Odds ratio-OR 1.410, 95% Confidence Interval-CI: 1.178–1.687, p 0.0002) (Yun et al, 2017).

2.2.5.2 Family history

Consanguinity, especially first degree relative marriages (when parents are closely related by blood), increases the prevalence of genetic congenital anomalies and nearly doubles the risk for neonatal and childhood death, intellectual disability and other anomalies (WHO, 2016a).In one study conducted in Saudi Arabia, a random sample survey of 6,421 Saudi infants and children was conducted to study the prevalence of consanguineous marriage and its effect on the prevalence of hereditary sensorineural hearing loss. The study shows that consanguinity is widely practiced among the population surveyed and demonstrated a marked adverse effect on the incidence of hereditary sensorineural hearing impairment(Zakzouk, El-Sayed , & Bafaqeeh , 1993). A similar result was produced in Qatar, a hearing loss prevalence of 5.2% has been reported with parental consanguinity being more common among affected individuals as compared with unaffected ones (Girotto et al, 2014).

A case-control study was designed on 420 infants with permanent hearing impairment and normal hearing from the year 2008 to 2012 in India (Selvarajan et al, 2013). Parent interview was carried out to collect the information of family history of hearing impairment and consanguineous marriage. Family history and consanguinity was seen in 18.6% and 39.5% of the hearing-impaired group. These factors were associated with hearing impairment with a high significance (OR 6.5; 95% CI 2.8- 15.1; *P* 0.000 and OR: 2.7; 95% CI 1.9-3.9; *P* 0.000). The combination of risk-factors is seen in 10% of the hearing-impaired group, whereas only 0.5% had it in the control group(Selvarajan, Arunachalam, & Bellur, 2013). Another study conducted in India shows the same result where a case control study was done using 50 congenitally deaf children and 50 children with normal hearing. A detailed history was taken from the parents with regard to family history of hearing loss and consanguinity. In the case group, 28% children had a family history of hearing loss and in the control group; none had a family history of hearing loss. In the case group, 48% of the children had parents with consanguinity. In the control group, 28% of the children had parents with consanguinity(Shrikrishna & Deepa , 2016).

In one study conducted in Iran, one hundred and forty parents of hearing impaired students in primary school and guidance school in Mashhad took part in the study. The questionnaire that consisted of some questions about the history of family and hearing loss was given to the mothers. The results showed that, in 61.4 % of people, consanguinity was present, which, first cousin consanguineous marriage was found among the parents of 43.6 % of the students and second cousin consanguinity was present in 17.9 % of them and there was significant relation between consanguineous marriage and having more than one disabled children in the family, as, 77.7% persons who had more than one child with disability, had consanguineous marriage(Amini & Kamali, 2010).

Hereditary hearing loss and deafness can be regarded as syndromic or non-syndromic. Syndromic hearing impairment is associated with malformations of the external ear, with malformations in other organs, or with medical problems involving other organ systems. Non-syndromic hearing impairment has no associated visible abnormalities of the external ear or any related medical problems; however, it can be associated with abnormalities of the middle ear and/or inner ear. Approximately 80% of pre-lingual deafness is genetic, most often autosomal recessive and non-syndromic (Smith et al, 2014). An inherited hearing loss does not necessarily mean that one or both parents also are hard-of-hearing. In fact, about 90 % of children with congenital hearing loss are born to hearing parents, who may have passed on the condition by being carriers of recessive genes (CDC, 2015b)

Hearing loss may begin before the development of speech (pre-lingual) or thereafter (post-lingual). Most pre-lingual forms are present at birth (congenital), but some start in early infancy before the acquisition of language. In most cases, pre-lingual hearing loss is severe but stable. Approximately 50% percent of cases are due to monogenic forms of hearing loss; perinatal factors and infantile infections or trauma are responsible for the other half. About 1 child in 1000 is born with pre-lingual hearing loss, of whom about half have genetically determined hearing loss. The inheritance pattern of monogenic pre-lingual hearing loss is autosomal recessive in approximately 75 percent of patients, autosomal dominant in approximately 20 percent, X-linked in approximately 5 percent, and mitochondrial in less than 1 percent(Willems, 2000)

2.2.5.3 Maternal factors

Non-genetic hearing loss is most often caused by illness or trauma before birth or during the birth process.

Maternal infection

Older infants and young children can also develop non-genetic hearing loss due to illness or trauma (Poonual et al, 2015). Some viral infections are known to be associated with hearing loss. These infections carry the highest risk of causing hearing loss if the mother has the illness during pregnancy or passes the infection to her baby during the birth process. The primary infections are Toxoplasmosis (Cat-scratch disease), Syphilis, Rubella (German measles), Cytomegalovirus (CMV) and Herpes (Smith et al 2014). The amount of hearing loss that can result varies widely and some babies show no hearing loss at all, even if they have one of these infections. These infections can affect other systems in the body as well and medical professionals will need extensive birth history and test information to identify these infections as a cause for hearing loss. In developed countries, however, the most common environmental, non-genetic cause of congenital hearing loss is CMV. Its overall birth prevalence is approximately 0.64%; 10% of this number have symptomatic CMV. Of asymptomatic cases, up to 4.4% develop unilateral or bilateral hearing loss before primary school, although there is marked ethnic variation (Smith et al, 2014).

Chronic diseases of mother

Infants of diabetic mothers were found to be at increased risk for hearing loss,cases with dysplastic external ears seen at Cedars-Sinai Medical Center were combined with case series in medical literature describing similar patients. Data from a large congenital birth defects registry in Spain were analyzed, and odds ratios for infants born to either a gestational or preconception diabetic mother were calculated. When infants of mothers with pre-conceptionally diagnosed type 1 or 2 diabetes were considered, the OR for oculo-auriculo-vertebral sequence was 1.50 (CI 0.08-9.99, P 0.49), and the OR for dysplastic ears was 0.94 (CI 0.48-1.81, P 0.85) (Wang , Martínez, & Graham, 2002).

Supplements before and during pregnancy

Antenatal vitamin A deficiency during sensitive periods of fetal development may represent an etiologically distinct and virtually unexplored causal pathway of congenital hearing impairment (Emmett & West, 2014). Evidence from multiple animal systems clearly shows that fetal inner ear development requires adequate vitamin A nutriture to proceed normally. Inner ear malformations occur in experimentally imposed maternal vitamin A deficiency in multiple species in a dose-response manner. These anomalies are likely due to the loss of retinoic acid-dependent regulation of both hindbrain development and otic morphogenic processes. Based on in vivo evidence in experimental animals. There is a hypothesis that preventable gestational vitamin A deficiency, especially during early stages of fetal development, may predispose offspring to inner ear malformations and sensorineural hearing loss(Emmett & West , 2014).

Folic acid requirements are increased in pregnancy because of the rapidly dividing cells in the fetus and elevated urinary losses. As the neural tube closes by day 28 of pregnancy, when pregnancy may not have been detected, folic acid supplementation after the first month of pregnancy will not prevent neural tube defects. However, it will contribute to other aspects of maternal and fetal health (WHO, 2012b). A person's blood concentration of folate and vitamin-B_{12} can be affected by many factors such as their deficiency during pregnancy, which may lead to the risk for neural tube birth defects, including cleft palate, hearing impairment, spina bifida, and brain damage (Taha et al, 2014). All women desirous of becoming pregnant should consume 400-800 microgram of folic acid daily. To be effective, supplementation should be started at least 1 month before conception, and continued through the first 2-3 month of pregnancy. (Sachdev & Shah, 2012).A case control study conducted in Egypt to evaluate the role of vitamin-B_{12} and folate blood concentrations in children suffering from moderate, severe, and severe-to-profound sensorineural hearing loss. The study demonstrated that the serum levels of folate and vitamin-B_{12} are decreased in patients with severe sensorineural hearing loss ($P < 0.001$) (Taha et al, 2014).

An experimental study on pigs indicate that mild maternal iron deficiency anemia in guinea pigs induced hearing impairment in offspring, and this deficit may be attributed to the reduction of synapse density in central nervous system (Yu et al, 2016). An observational study wasdone in India to study the adverse effects of maternal anemia, 1000 mothers admitted for delivery were recruited and their hemoglobin was measured. Mean birth weight of babies born to anemic mothers was marginally lower compared to that of babies born to non-anemic mothers. This difference was statistically significant. There was 6.5% increase in the incidence of low birth weight babies and 11.5% increase in preterm deliveries in mothers who were anemic in their third trimester (Kumar et al, 2013). Prematurity and low birth weight are known risk factors of hearing impairment. Anotherprospective cohort study was performed at Sir Ganga Ram Hospital, India to determine whether in utero iron status is associated with auditory neural maturation in late preterm and term infants. Twenty-three infants had latent iron deficiency, Latent iron deficiency was found to be associated with abnormal auditory neural maturation in infants at ≥34-week gestational age($P < 0.05$) (Choudhury et al, 2015). WHO recommends strongly that each pregnant woman should have daily oral iron and folic acid supplementation as part of the antenatal care to reduce the risk of low birth weight, maternal anemia and iron deficiency. This recommendation was a result of data review, the review included 60 randomized controlled trials with 27 402 women from 30 different countries in all continents. Overall, women taking daily iron supplements were less likely to have low birth weight babies compared with controls (average relative risk (RR 0.81, 95% CI 0.68 – 0.97, 11 studies) (WHO, 2012b), Itself low birth weight is recognized as a risk factor of hearing impairment in children.

Medications use during pregnancy

The use of medication was studied as a risk factor. An association was found in a study in Egypt, A total of 555 children (6–12 years of age) from a rural and an urban school in the Shebin El-Kom District of Egypt were screened for hearing impairment at their schools. Risk factors were investigated through a parent questionnaire and an environmental study consisting of noise, ventilation, and crowding measurements at the schools. The study showed a significant relationship between hearing impairment and pregnancy drug misuse (OR 0.23 CI 0.07- 0.71 P value 0.006)(Taha & Pratt, 2010).

Another study was conducted in Michigan to study the effect of Aspirin ingestion and cerebral palsy was done. Thestudy included 877 infants born <28 weeks' gestation.

Mothers were interviewed, charts were reviewed. After adjustment for the potential confounding of disorders for which medications might have been indicated, the risk of quadriplegiccerebral palsy remained elevated among the infants of mothers who consumed aspirin (OR 3.0; 95% CI 1.3-6.9). The possibility that aspirin use in pregnancy could lead to perinatal brain damage cannot be excluded (Tyler et al., 2012). The relation with hearing impairment is not clear but it's a part of nervous system. The use of high doses (>100milligram) of aspirin during pregnancy poses various risks depending on the stage of pregnancy. During the first trimester, use of higher doses of aspirin poses a concern for pregnancy loss and congenital defects. Taking higher doses of aspirin during the third trimester increases the risk of the premature closure of a vessel in the fetus's heart. Use of high-dose aspirin for long periods in pregnancy also increases the risk of bleeding in the brain of premature infants(Tobah, 2015).

Hair coloring during pregnancy

Dying or coloring hair was excused to cause congenital anomalies. A case-controlled retrospective studies were done in order to investigate the fetal impacts of exposure to hair dye in Sweden in 2002, compared with the referents, the hairdressers more often gave birth to infants that were small for gestational age (OR: 1.5, p 0.004), in addition, a higher fraction of the infants born to a hairdresser had a major malformation (2.8% v 2.1%) (Rylander et al, 2002).Contradictory a case-control study of 525 black women from three counties in North Carolina who had delivered a singleton, live born infant examined whether exposure to chemicals used in hair straightening and curling increased the odds that the infant was preterm or low birth weight. The study concluded that women who used a chemical hair straightener at any time during pregnancy or within 3 months prior to conception had an adjusted OR of 0.7 Cl 0.4−1.1 for preterm birth and 0.6 (Cl 0.4−1.1) for LBW. Exposure to chemical curl products was also not associated with preterm delivery (adjusted OR 0.9 Cl 0.5−1.8) or LBW (adjusted OR 1.0, 95% Cl 0.5−1.9) (Blackmore-Prince et al, 1999). The literature suggests that the reliability of using hair dye during pregnancy has still been controversial in terms of both teratological and carcinogenic effects (Api & fien, 2014).

Maternal exposure to imaging

Maternal exposure to imaging could affect the development of nervous system of her fetus. As the period of fetal neurological development is long and because it is the most radiation-sensitive system, radiation-induced abnormalities are usually accompanied by neuropathology. There are a number of considerations in estimating fetal dose from external radiation sources. The uterus shields the fetus from radiation sources external to the mother. Fetal dose is affected by maternal anatomy, including uterine position and bladder distension. The irradiation of the fetus may not be uniform as the fetus grows larger. And, finally, the mother may have had more than one exposure(Australian Government Department of Health, 2012). The effects of ionized radiation on the fetus during pregnancy have become remarkable because imaging modalities are frequently used today. The clinical approach is to use the least amount of radiation, and as much as possible, to use imaging methods that do not contain radiation (ultrasonography, Magnetic Resonance Imaging-MRI) Although MRI seems safe especially in the second and third trimesters, it is thought that radiofrequency waves and high acoustic media may negatively affect fetal tissues in the first trimester, and especially in the organogenesis period(Uygun, 2017).One study conducted in Canada to evaluate the long-term safety after exposure to MRI in the first trimester of pregnancy, the risk of stillbirth or neonatal death within 28 days of birth and any congenital anomaly, neoplasm, and hearing or vision loss was evaluated from birth to age 4 years.Universal health care databases in the province of Ontario, Canada, were used to identify all births of more than 20 weeks, from 2003-2015. The study conclusion was exposure to MRI during the first trimester of pregnancy compared with non-exposure was not associated with increased risk of harm to the fetus or in early childhood (Ray et al, 2016).

Maternal exposure to trauma

Maternal trauma was studied by two population-based databases (inpatient and ambulatory care) were conducted in China to identify pregnant women who had severe (required hospitalization) or minor injuries (required ambulatory care only) prenatally. The study concluded that trauma during pregnancy, whether minor or severe, is associated with unfavorable maternal outcomes. Injuries considered minor for the general population are not minor for pregnant women. While minor injuries were associated with preterm labor (OR 1.25), a severe injury was strongly associated with increased risks of preterm labor, placental abruption, uterine rupture, and maternal death, especially during the third trimester (OR = 2.71, 6.12, 7.79, and 20.15, respectively) (Han-Tsung et al, 2012). A case control study was done to estimate associations between exposure to the events of September 11, 2001, and pregnancy poor outcome. Among 3360 births, 5.8% were low birth weight, 6.5% were preterm delivery, and 9% were mall size for gestational age. The study concluded that Disasters on the magnitude of 9/11 may exert effects on reproductive outcomes for several years. Women who are pregnant during and after a disaster should be closely monitored for physical and psychological sequelae (Maslow et al, 2016).

Maternal exposure to loud noise during pregnancy

Results of different studies suggest that exposure to excessive noise during pregnancy may result in high-frequency hearing loss in newborns and may be associated with prematurity and intrauterine growth retardation (CDC, 2017b).

Complications during delivery

A longitudinal prospective observational study was conducted at a tertiary care hospital in India, A total of 415 babies were included in the study whichshowed that ante-partum bleeding and history of maternal blood transfusion were risk factors associated with hearing loss in new born(p 0.037) (Gouri et al, 2015).

2.2.5.4 Fetal and childhood factors

Complications at birth, such as lack of oxygen, low birth weight, prematurity and jaundice, account for 17% of childhood hearing loss (WHO, 2016b). Fetal factors are related and affect each other. Most of the studies and research identified fetal and child exposures and risk factors in combination as they may have synergistic effect.

Cranio-facial anomalies

It is well documented that children with cranio-facial anomalies are at a greater risk of hearing impairment and middle ear pathology than children without craniofacial anomalies. Most research has focused on the hearing loss present in this population during the first few months of life. However, recent research has indicated that even if these infants pass newborn hearing screening at birth, on-going monitoring of hearing throughout childhood is required due to their increased risk of developing a postnatal hearing loss. A recent study revealed that children with craniofacial anomalies are 2.6 times more likely to develop a postnatal hearing loss than children without craniofacial anomalies (Beswick & Driscoll, 2013). The study was retrospective, and involved children who were born in Queensland, Australia, between September 2004 and December 2009. During the study period, 2107 children met the inclusion criteria and were included in this study. Of these, 56 children (2.7%) were identified with a postnatal hearing loss. Statistical analysis revealed that two risk factors, family history (OR1.92 CI: 1.04-3.56), and craniofacial anomalies (OR 2.61 CI: 1.19-5.70) predicted the occurrence of postnatal hearing loss in children (Beswick et al, 2013).

Prematurity and low birth weight

Low birth weight has been identified as a risk factor for hearing loss (WHO, 2013a). In very low birthweight or preterm populations, the prevalence of high frequency hearing loss among survivors is about 10 times the incidence in unselected populations.Various etiological mechanisms have been suggested, including bilirubin and drug toxicity,hypoxic brainstem injury, hemorrhage into the inner ear, acoustic trauma, and CMV infection. The causes of Sensory Neural Hearing Loss (SNHL) in very preterm infants may differ from those in more mature children as, in parallel with other neurological structures, the period between 20 and 33 weeks' gestation is one of rapid fetal audiological development. Among very preterm deaths, labyrinthine pathology may be found in a considerable number of cases (Elaine , Hunt, & Marlow, 2000).A case control study was done in Poland. By analyzing the database of the Polish Universal Newborns Hearing Screening Program from 2010 to 2013. The study group involved 11438 infants born before 33 weeks, the control group was 1487730 infants. Hearing deficit was diagnosed in 11% of infants ≤25 weeks, 5% at 26–27 weeks, 3.46% at 28 weeks and 2–3% at 29–32 weeks. In the control group the incidence of hearing deficit was 0.2%. The most important risk factors were craniofacial malformations, very low birth weight, low Apgar score and mechanical ventilation (Seniuk et al, 2017).

Another study was conducted at the Department of Laryngology in the Upper Silesian Center for Child Health in Katowice (Poland) to evaluate the frequency of risk factors and their influence on the distribution and manifestation of hearing loss in infants. A total of 5282 infants were examined. Subjects were categorized into two groups: the first group consisted of 2986 (56.53%) neonates with risk factors of hearing loss, while the second group included 2296 (43.47%) neonates without any known risk factors. The largest percentage of SNHL (15.52%) appeared in children with identified or suspected syndromes associated with hearing loss. The next highest frequency of SNHL was comprised of children subjected to mechanical ventilation for a period in excess of 5 days (11.45%). Only a small percentage (2.86%) of SNHL appeared to be due to the use of ototoxic medications. After ototoxic medications, the frequencies of risk factors were premature birth (16.21%); LBW (12.04%); intensive care in excess of 7 days (10.64%)(Bielecki, Horbulewicz , & Wolan, 2011).

Admission to NICU and mechanical ventilation

Admission to NICU has many associated risk factors of hearing impairment. In one cross sectional study conducted in Iran, 124 neonates included in the study. There was a significant statistical relationship between gestational age of less than 36 weeks (P 0.013), antibiotic therapy (P 0.033), oxygen therapy (P 0.04), and hearing loss (Pourarian et al, 2012). Another cross-sectional study conducted also in Iran including 514 infants. The study showed that hearing loss in neonates admitted to NICU is more common than general population (Baradaranfar et al, 2014). A longitudinal prospective observational study was conducted at a tertiary care hospital in India. A total of 415 babies were included in the study to assess the incidence of hearing damage and associated risk factors. The study showed that ante-partum bleeding, history of maternal blood transfusion, fetal distress, prematurity, severe birth asphyxia, NICU admission for more than 24 h and Apgar score less than five at 5 min were identified as risk factors for hearing impairment in children (Gouri et al, 2015).

Severe hyperbilirubinemia

Hyperbilirubinemia (jaundice) that is severe enough to require a blood transfusion can also result in hearing loss. This is related to the potential damage that high levels of bilirubin can cause to the nerves of hearing (National Institute on Deafness and Other Communication Disorders, 2014). The auditory pathway is the most sensitive part of the central nervous system to bilirubin-induced toxicity, and permanent sequelae may result from only moderately elevated total serum/plasma bilirubin levels. The damage to the auditory system occurs primarily within the brainstem and cranial nerve VIII, and manifests clinically as auditory neuropathy spectrum disorder (Olds & Oghalai, 2015).One study was conducted in Spainto identify the relationship between hyperbilirubinemia at birth as a risk factor and sensorineural hearing loss in children born from 2007 to 2011. The study showed that the percentage of children diagnosed with sensorineural hearing loss that suffered hyperbilirubinemia at birth is higher than for the general population (Santana et al, 2015). A similar finding resulted from a study including Infants born in Northern California hospitals from 1995-2011. A nested double cohort design was used. The study concluded that only bilirubin levels ≥ 35 mg/dL were associated with a statistically significant increased risk of SNHL (OR: 91 CI: 32 to 255) or bilirubin level ≥ 10 mg/dL above the exchange transfusion threshold, the OR for sensorineural hearing loss was 36.0 (CI 13-101). At lower bilirubin levels, the excess risk of SNHL was low(Wickremasinghe et al, 2015). A retrospective study of 796 newborns with hyperbilirubinemia at birth, conducted in Spain to analyze newborn hyperbilirubinemia as risk factor for hearing loss in children born in the Hospital of Insular Maternal and Child University Hospital Complex, between 2007 and 2013. The percentage of children diagnosed with sensorineural hearing loss whosuffered hyperbilirubinemia at birth is higher than for the general population. Of thosediagnosed none had levels of indirect bilirubin ≥ 20 mg/dl, only 47% had hyperbilirubinemiaat birth as a risk factor and 53% had another auditory risk factor associated(González et al, 2017).A retrospective, case-control study was done in Mexico to determine frequency of sensorineural hearing loss in infants with hyperbilirubinemia treated with exchange-transfusion. The sample size was 102 children, 15% of children presented with SNHL. Preterm newborns presented more often with SNHL. Indirect bilirubin level was higher in children with SNHL (22.2 versus 18.7mg/dL, $P = 0.02$).The study disclosed a high frequency of SNHL in children with neonatal hyperbilirubinemia and exchange-transfusion (Cruz et al, 2014)

Bacterial meningitis

Hearing impairment was identified as one complication of bacterial meningitis. A study aimed to examine hearing function in children admitted with bacterial meningitis to determine the risk factors for sensorineural hearing loss, was conducted in Kenya. The study involved 83 children. Thirty six of the 83 children (44.4%) were found to have at least a unilateral mild sensorineural hearing loss during initial audiological testing. Of the children with hearing loss, 22 (26.5%) had mild or moderate sensorineural hearing loss and 14 (16.9%) had severe or profound sensorineural hearing loss. Significant determinants identified for hearing loss included coma score below eight, seizures, cranial nerve neuropathy, positive cerebrospinal fluid culture, and fever above 38.7 °c.The study concluded that sensorineural hearing loss was found to be highly prevalent in children treated for bacterial meningitis (Karanja et al, 2014).

Recurrent otitis media

Otitis media can affect hearing ability. There are three tiny bones in the middle ear which carry sound vibrations from the eardrum to the inner ear, when fluid is present, the vibrations are not transmitted efficiently and sound energy is lost. The result may be mild or even moderate hearing loss. Therefore, speech sounds are muffled or inaudible. Generally, this type of hearing loss is conductive and is temporary. However, when otitis media occurs over and over again, damage to the eardrum, the bones of the ear, or even the hearing nerve can occur and cause a permanent, sensorineural hearing loss (The American Speech-Language-Hearing Association, 2017).Another explanation that middle ear infection happens often in young children because Eustachian tubes, aren't fully formed. Fluid builds up behind the eardrum and can get infected. Even if there's no pain or infection, the fluid can affect hearing if it stays there, at least for a short time. In severe and long-lasting cases, otitis media can lead to permanent hearing loss(Borgia, 2016).

Ototoxic medications

Medicines, such as those used in the treatment of neonatal infections, malaria, drugresistant tuberculosis and cancers, can lead to permanent hearing loss (WHO, 2013a).Any drug with the potential to cause toxic reactions to structures of the inner ear, including the cochlea, vestibule, semicircular canals, and otoliths, is considered ototoxic. Drug-induced damage to these structures of the auditory and balance system can result in hearing loss, tinnitus, and disequilibrium or dizziness.Ototoxicity is typically associated with bilateral high-frequency SNHL and tinnitus. Hearing loss can be temporary but is usually irreversible with most agents. Generally, antibiotic-induced ototoxicity is bilaterally symmetrical, but it can be asymmetrical. The usual time of onset is often unpredictable and marked hearing loss can occur even after a single dose. Additionally, hearing loss may not manifest until several weeks or months after completion of antibiotic or antineoplastic therapy(Mudd, 2016).Use of ototoxic medicines in pregnant women and children is responsible for 4% of childhood hearing loss, which could potentially be avoided (WHO, 2016b). A study conducted in Northern Thailand to define the risk factors for hearing loss in infants (aged 3 months) under universal hearing screening program concluded that low birth weight, APGAR score <6 at 5 minutes, craniofacial anomalies, sepsis, and ototoxic exposure are the risk factors for bilateral hearing loss in infants (Poonual et al, 2015).

In one retrospective cohort study included 267 singleton neonates who were born alive after ≤ 32 weeks, administration of antenatal corticosteroids was related to a normal neonatal hearing screening test result (Kim, Choi, & Park, 2017).

Short birth interval

Short birth interval shorter than had been studied and was found to be associated withprematurity, fetal death, low birth weight and small size for gestational age (WHO, 2007). All mentioned complications are associated with hearing impairment

Bottle feeding

The entire population of 103,835 term newborns in Flanders, Belgium, was tested by a universal neonatal hearing screening program using automated auditory brainstem responses. Socio-demographic risk factors were investigated across the entire population to study any relationship with congenital hearing impairment. The study showed a significant association between bottle feeding and the prevalence of congenital hearing impairment (p value 0.002, OR 1.747 CI 1.225–2.491) (Kerschaver et al, 2013).

2.2.5.5 Health services provision factors

According to a report done by WHO based on data obtained through a meta-analysis conducted by the Prevention of Deafness and Blindness Program at WHO, over 30% of childhood hearing loss is caused by infections, most of these infections can be prevented by immunization and good hygiene (WHO, 2016b). Access to health care services during preconception period, pregnancy, delivery and postnatal period affect the outcome of pregnancy. Early prenatal care can provide necessary information to the mother and effect changes for nutrition-related and behavioral risk factors impacting the mother and baby (CDC, 2017). WHO reports showed that immunization against Rubella has decreased the incidence of congenital hearing loss (WHO, 2010).

Preconception care is a set of interventions intended to identify and to modify biomedical, behavioral, and social risks in women of reproductive age. The goal of preconception care is to improve pregnancy outcomes and women's health in general through prevention of disease and management of risk factors that affect pregnancy outcome and the health of future generations(Tydén, 2016).PCC has a positive effect on a range of health outcomes as it can reduce maternal and child mortality, prevent complications during pregnancy and delivery, prevent stillbirths, preterm birth and low birth weight, prevent birth defects, and prevent neonatal infections (WHO, 2013b)**.** In high-income countries women postpone childbearing until ages when their fecundity has decreased, whereas women in low-income countries would benefit from delaying pregnancy and spacing of subsequent pregnancies. Since the most critical period for organ development occurs before many women even know they are pregnant, the first contact with antenatal care is often too late for advice about health-promoting changes in lifestyle. Moreover, there is a growing body of evidence that women's, and also men's, health and lifestyle before conception can affect pregnancy outcomes. Women with chronic diseases such as SLE and diabetes, hypertension, and obesity face unique reproductive planning challenges(Tydén, 2016).

Good care during pregnancy is important for the health of the mother and the development of the unborn baby. Pregnancy is a crucial time to promote healthy behaviors and parenting skills. Good ANC links the woman and her family with the formal health system, increases the chance of using a skilled attendant at birth and contributes to good health through the life cycle. Inadequate care during this time breaks a critical link in the continuum of care, and effects both women and babies (WHO, 2016c). Most problems at birth are caused by prematurity, fetal growth restriction, congenital abnormalities or asphyxia. With access to antenatal care, especially in early pregnancy, many of these can be prevented or anticipated. Particularly relevant in this respect are modifiable life-style risks such as smoking, alcohol consumption, drug abuse, obesity, malnutrition, inadequate folic acid intake and occupational exposures(Fraser, 2013).

A case-control study was conducted in Brazil, 2004 to 2008, the purpose of this study was to analyze ANC adequacy and its relationship with LBW in the Unified Health System in Brazil. The study population consisted of two groups, each with 860 newborns. The study suggested an association between inadequate number of ANC visits(OR 1.78, CI 1.32-2.34), laboratory studies and exams(OR 4.13, CI 1.36-12.51), and increased risk of LBW newborns (Fonseca et al, 2014).A cross-sectional study conducted in Iraqto show the association between antenatal care and birth weight. The studyinvolved 225 newborns recruited randomly from four General Hospitals in different areas of Baghdad were carried out in 2009. Mothers of these infants were interviewed within 24 hours after delivery. The study concluded that antenatal care of the pregnant mothers is one of the important risk factors contributing to low birth weight babies. Even though the average number of antenatal visits was satisfactory, early booking at a health center need to be properly advocated to mothers to avoid poor birth outcome such as low birth weight (Abdal Qader et al, 2012). A research was done in remote areas in Pakistan to assess low birth weight delivery factors among pregnant women. The study used mixed methodology through structured data collection from medical records followed by interviews and focus group discussions to understand the causes and their remedies. The study showed that mothers who received antenatal care were more likely to deliver normal weight babies compared to those who did not (OR 4.3 CI 2.6-7.3 p <0.001). Women with more than four antenatal visits were six times as likely to deliver normal weight babies (OR 5.54 CI 3.8-8.1 p <0.001) (Ahmed, Khoja, & Tirmizi, 2012).

Strengthen immunization programs can prevent many of the infections that lead to hearing loss, such as congenital rubella, meningitis, mumps and measles. Potentially, over 19% of childhood hearing loss could be avoided through immunization against rubella and meningitis (WHO, 2016b)

2.2.5.6 Environmental factors

Maternal exposure to certain pesticides and other chemicals, as well as certain medications, alcohol, tobacco and radiation during pregnancy, may increase the risk of having a fetus or neonate affected by congenital defect (WHO, 2016a).

Exposure to loud soundsfor prolonged periods can lead to hearing loss. Even short, high intensity sounds, such as fireworks and shooting, may cause permanent hearing loss. The noisy machinery in a neonatal intensive care unit can also contribute to hearing loss (WHO, 2016b).

Exposure to loud noise

Exposure of pregnant women to occupational noise is suspected to be a risk factor of hearing dysfunction in children (Selander et al, 2016). A population-based cohort study was conducted in Sweden. The aim of this study was to investigatewhether occupational exposureto noise during pregnancy is associated with hearing dysfunction in children. This study included 1,422,333 single births from 1986 to 2008. This study showed an association between occupational noise exposure during pregnancy and hearing dysfunction in children (OR 1.82 CI 1.08- 3.08) (Selander et al, 2016). The risk of hearing loss from any source of noise is always a function of exposure intensity (volume) and duration. Noise exposures encountered by children include involuntary (environmental) and voluntary (school activities, listening to loud music) sources(Viet et al, 2014). Environmental noise includes transient noise intrusions from outdoors, such as airplanes, railways, motor vehicles, construction, industrial, or outdoor events, as well as indoor sources, such as television, music, appliances, and ventilation equipment. Some noise can arise from either outdoors or indoors, such as sounds made by neighbors, talk, laughter, slamming doors, and noise from barking dogs. Internationally, urbanization, growing demand for motorized transport, and inefficient city planning and zoning are the main driving forces for increasing environmental noise exposure (Viet et al, 2014).People of all ages including children can develop noise induced hearing loss (NIHL). NIHL can be caused by a one-time exposure to an intense impulse sound such as an explosion, or through continuous exposure to loud sounds over a long period of time, such as noise generated in a steel mill. Recreational activities that may place a person at risk for NIHL include hunting, shooting, playing in a band, attending loud concerts, listening to MP3 players at high volume through earbuds/headphones. Harmful noises at home might come from sources such as leaf blowers, lawnmowers and the use of power tools (Weiss, 2016). In a Scandinavian research hearing tests in 538 teenage boys revealed a hearing loss in 15% and that the characteristics of the loss is indicated that the majority were related to noise exposure. Similarly, a German review of clinical data estimates that one in ten adolescents has some degree of noise induced hearing loss from “leisure time noise.” In a recent Chinese study of 120 young users of “personal listening devices,” impaired hearing (>25 dB loss) was found in 14% of ears. A French audiometric survey of 1364 young subjects found evidence of hearing problems in 12% of the general population, and in a sub-group that often, attended rock concerts or used “personal cassette players” for more than 7 hours a week, 66% had a hearing loss. A similar finding was reported in a smaller group of German teenagers(Harrison, 2012).

Exposure to chemicals

Environmental chemical exposure can cause neurotoxicity and has been recently linked to hearing loss in general population. A case control study aimed to evaluate the association of lead and cadmium exposure with pediatric hearing ability. A sample of 234 preschool children in 3–7 years of age from an electronic waste recycling area and a reference area matched in Shantou of southern China. A higher median blood lead level was found in the exposed group (4.94 ± 0.20 vs 3.85 ± 1.81 μg/dL, $p < 0.001$). The study suggested that early childhood exposure to lead may be an important risk factor for hearing loss, and the developmental auditory system might be affected in e-waste polluted areas (Liu et al, 2018).

Exposure to smoking

Exposure to negative smoking was studied in Egypt to assessit as potential risk factor for development of sensorineural hearing loss. The study was done between January 2010 and November 2012. The sample included 411 children aged 5-11 years. The study showed that passive smoking in childhood correlates with sensorineural hearing loss, and it is an important risk factor for development of minimal hearing loss (OR 3.14 CI 1.18- 8.3 p <0.05) for heavy exposure group (mother was smoking, or the father was freely smoking at home and in the presence of his children) (Sanyelbhaa et al, 2014). An experimental study was done on pregnant mice suggested that nicotine exposure, before and after birth, can cause a child to have hearing problems due to abnormal development in the auditory brainstem(Baumann & Koch, 2017). A study conducted in Brazil to analyze the effect of tobacco smoke exposure during childhood on cochlear physiology by measuring the transient evoked otoacoustic emissions response levels. Cotinine, the main metabolite of nicotine, was measured in 145 students' (8–10 years old) urine. The mean hearing loss in tobacco smoke exposure children was 2.1 dB SPL. These results have important implications on the damage to the cochlear structures and indicate a possible loss in hearing and hearing ability development (Durante et al, 2013).

Exposure to garbage

The garbage in any area or dumping ground is a good breeding ground for flies, cockroaches, insects and mosquitoes. They can infect people and are considered as the carriers of various diseases. Garbage not only causes land pollution but also air pollution by emission of harmful gases, when it is burnt which remains in breathing zone of animals and human beings. Burning garbage may release toxic material, dioxin which is considered to be carcinogenic(Sarkar, 2016). The relationship between hearing impairment and garbage in not clear and direct.

Exposure to fuel

Exposure to fuel is found to be associated with hearing impairment in some studies. One experimental study on rats was conducted to evaluate the effect of one kind of jet fuel (JP-8) mainly used in military on hearing. The results indicated that jet fuel exposure may exert consequences on auditory function that may be more widespread and insidious than what was previously known. It is possible that a large population of military personnel who are suffering from the effects of jet fuel exposure may be misidentified because they would exhibit normal hearing thresholds but harbor a "hidden" brainstem dysfunction (Guthrie et al, 2014). And depending on this study, andbecause JP-8 is essentially the same as other hydrocarbon fuels, differing mainly in the chemical percentages, the same risk that aircrews, pilots, and mechanics face may also affect anyone who is consistently around other types of fuels. This can include, for example, truck drivers, gasstation attendants, and potentially even passengers who are frequent flyers on commercial jets(Office of Research

& Development, 2014). A paper was prepared in conference to discuss the effect of petrol stations on health. It is concluded that, in conditions of long term exposure, toxic gases may adversely affect human health. For example, smoke affects the respiratory organs and the skin, lead affects the respiratory, the nervous and the cardiovascular system, the nitric oxides cause asthma, allergies and malignant diseases. Hard particles from the combustion are also cancerous(Dimiskovka, 2012)

Methodology

3.1 Study design

The design of this study is analytic one in the form of case-control study that has been used to identify the possible risk factors of hearing impairment in Gaza.Analytic research generates new knowledge about concepts and can identify relationships between variables.A case-control study is designed to help determine if an exposure is associated with an outcome or not (i.e., disease or condition of interest).Case-control studies have specific advantages compared to other study designs as they are comparatively quick, inexpensive, and easy in comparison to cohort or experimental research(Lewallen & Courtright, 1998). In this study, data were collected about the cases (children with hearing impairment) and also about controls (children free from hearing impairment). The researcher used matched case control design (by age) with one control for each case.

3.2 Study population

The study includes two populations, cases and controls. Cases are children who are diagnosed to have hearing impairment aged 0-3 years.Cases were selected randomly from the available list in ASDC which includes 695 children born since 2014,diagnosed tohave different types of hearing impairment before their 3^{rd} birthday.Cases with moderate, severe and profound neurosensory hearing impairment were chosen, the total number of children who were diagnosed to have neurosensory hearing impairment was 203 children. Children with conductive and temporary hearing loss where excluded.

Controls are thechildren aged 0-3years who are free from hearing impairment as proven by the screening conducted by ASDC. Controls were selected randomly from the available list in ASDC, UNRWA, MOH and Near East Council of Churches (NECC)as being free from hearing impairment. The number of screened children who are proven to be free from impairment is more than 2000.

3.3 Study setting

Cases were randomly selected from ASDC, which serves children with hearing impairment. Controls were selected from children without hearing impairmentidentified by the same screening programconducted by ASDC at MOH, UNRWA and NGOs and proven to be free from any kind of hearing loss. Both cases and controls were interviewed at households.

3.4 Study period

The study was initially proposed in February 2017. The proposal of the research was submitted and defended in the front of School of Public Health (SPH) committee in May 2017. Upon the approval, the researcher started to develop the research questionnaire. The researcher consulted 9 experts to modify the tools. By reviewing more literature and studies the questionnaire was designed in August 2017 and remodified by experts' comments in September 2017. In October 2017 the researcher contracted 4 data collectors and carried out the required training before piloting and field work. Pilot study was carried out during the first week of October where 10 cases and 10 controls were interviewed. Some questions were added or modified after piloting. Data collection started in November 2017 through January 2018. Some delay was resulted from unavailability of controls or their addresses. Data entry started with coincidence with data collection. A data entry model was developed on the Statistical Package of Social Science (SPSS) program. The data entry ended in February 2018.

Data analysis started in Feb 2018 and ended in March 2018. In parallel to analysis, the researcher stared to create the descriptive tables followed by inferential tables and graphs. The researcher started to conclude the findings and discussion by linking the results with the literature.A final draft was submitted on 2.7.2018 to the supervisor after modifications according to his advices and comments.

3.5 Eligibility criteria

3.5.1 Inclusion

Cases were operationally defined as children, below 3yearsat the time of diagnosis who were confirmed to suffer from neurosensory hearing impairment and registered at ASDC during the years (2014 through 2017). The researcher aimed to focus on perinatal and early life events that would affect hearing development.By reviewing the available data, it was found that most congenital or early onset hearing impairment cases are diagnosed before their 3rd birthday. Also, the selection of this age group has considered the availability of controls, as the screening program is not ongoing one, indeed it depends on ad hoc projects(Abu Hamad, 2011).

Controls were operationally defined as children who are free from hearing impairments as they were tested and proven to be free.Those were assessed according to ASDC screening protocol and pass the test (having no impairment). As aforementioned, each case wasmatched by one control from the same age group (plus minus 2 months).

3.5.2 Exclusion

Any child doesn’t meet the above criteria

3.6 Sampling

According to the annual report of ASDC, 140 children (0-5) in 2014 and 167 children in 2015 were included in early intervention program (ASDC, 2015; ASDC, 2014).ASDC discovered those cases by screening program conducted all over the Gaza Strip. The researcher used Epi-Info sample size statistical calculator version 7.2.1.0 and considered the following parameters:

- Confidence level is 95%
- The odds ratio is assumed to equal 2
- The power is81%
- Ratio of cases to controls 1
- Percent of controls exposed 50%
- The suggested sample size for cases is 152and 152 for controls.

The researcher increased the numbers of cases to 170 cases. Moreover, 170 casesfree from hearing impairmentwere selected as controls.Annex 2 shows the sample calculation using the Epi info program. The sample delivered by the statistical calculator of the Epi-info were double checked to assess its suitability for matched control case study and findings were confirmative. Both the cases and controls were randomly systematically selected from the available lists at ASDC after applying the eligibility criteria. The contact information was available for cases from ASDC, on other hands the contact information of controls was generated from UNRWA, MOH and NECCdata.

3.7 Study instruments

The study instrument is self-constructed structured questionnaire, the researcher developed the questionnaire after reviewing the literature, and then the researcher reviewed some questionnaires related to other types of disabilities.At the end the researcher listed the possible risk factors and formulated the questions according to the context. As mentioned before, the questionnaire was reviewed by experts and their comments were taken in consideration. The pilot study helped in formulating the final copy of the questionnaire. The main items of the questionnaire are:

1. Demographic information
2. Socioeconomic and cultural factors
3. Family history
4. Medical history of genetic related diseases
5. Maternal, obstetric and medical history and services
6. Fetal and childhood diseases
7. Available Health services
8. Environmental conditions and exposure to pollution, and hazard materials

3.8 Ethical and administrative considerations

An academic approval was obtained from the School of Public Health at Al-Quds University and an ethical approval was obtained from Helsinki Committee (Annex7). Administrative approval was obtained from the directors of ASDC, UNRWA, MOH and NECC to access the organizations database. To guarantee adherence to research ethics, a covering letter explaining the aim of the research was available, also the researcher clarified for all respondents that their participation is voluntary and confidentiality was assured for all of them.Most importantly, informed consent and approval was obtained from each participant. The questionnaires were filled at participants' homes after calling them and booking appropriate appointments. All questionnairesand data were dealt with in a confidential and ethical manner.

3.9 Pilot Study

A pilot study on 20 clients, 10 cases and 10 controls was done to explore the appropriateness of the study instruments and to inform the train of the data collectors. This helped in further improvement of the study validity and reliability of the study. Modifications of some questions were done and some new questions were added after pilot study.

3.10 Data Collection

The researcher and 4 trained data collectors collected the data through face to face interview. The questionnaire has been completed through a face to face interview (at home) with the caregiver of the child with or without hearing impairment. A training was conducted on how to ask the questions, complete the questionnaires in order to standardize the data collection process and improve reliability of the data collection. Filling the questionnaire required around 25 minutes. Medical records and reports were revised to ascertain the diagnosis. Unclear diagnosis or lack of clarity about the diagnosis led to the exclusion of the cases.

3.11 Response rate

All participants were called before interviewing and asked to participate in the research. The aim and confidentiality were explained. The response rate was high (99.4%), only two families refused to participate.

3.12 Scientific rigor

3.12.1 Reliability

The following steps were done to assure reliability

- Training of data collectors on interviewingskills and the way of asking questions. This assured standardization of questionnaire filling.
- Ongoing checking and verifications of the completed questionnaires by different levels including filed supervisor and the researcher.
- Standardization of implementation,

- The data entry within one week of data collection allowed possible interventions to check the data quality or to re-fill the questionnaire when required.

3.12.2 Validity

The questionnaire was evaluated by 9 experts to assess its relevance, and their comments were taken in consideration. They were 3 epidemiologists, 3 pediatricians, two ENT specialists and one audiology specialist (annex shows their names and titles). The researcher visited ASDC to know the ways and instruments of screening and diagnosis and attended one session of ABR Also, a pilot study was conducted before the actual data collection to examine clients' responses to the questionnaire and how they understand it. This enhanced the validity of the questionnaire after modifying it to be better understood. Also, checking records helped in validating the responses provided by mothers as much as possible.

3.13 Data entry and analysis

Throughout data collection, the team leader of data collectors checked the filled questionnaire and complete any missing information by recalling the families. Then the filled questionnaires were rechecked by the researcher before data entry. Data entry model was designed by the researcher, all the Questionnaires and variables were coded and entered. The researcher usedSPSS program-version 21 for data entry and analysis.The process of data entry was performed in one week of field work and continued for two weeks after the end of data collection. Also, about 10% of the data was re-entered. This was followed by cleaning the data by checking all the frequencies to check any error or illogical value.Descriptive results were presented using mean and standard deviation for continuous variables and percentages for categorical variables. Some continuous variables were recoded into categorical variables according to the need and literature.To explore the differences between cases and controls with categorical data, Chi-square test wasusedto compare between cases and controls and having a family history of hearing impairment (yes or no questions), consanguinity, maternal history, admission to NICU and environmental exposures. If any violation of chi- square assumption existed, Fisher's Exact Testwas used. Odds ratio were used to analyze associations between groups from case-control.When one variable is continuous like gestational age, birth weight and birth interval, t test was used to explore differences between cases and controls.Regression analysis model was run for group of variables constituting certain domain to explore the possible interactions between these statistically significant variables.

3.14 Limitations of the study

- Due to the retrospective nature of case-control studies they are particularly susceptible to the effects of bias. Cases and controls may recall past exposure differently, because knowledge of being a case may affect whether the individual remembers a certain exposure, for example (recall bias). However, this has been minimized by setting eligibility criteria and appropriate probing
- Only cases who are registered in ASDCwill be interviewed. Some cases are not registered as these are not discovered. However, ASDC is the only organization that performs the ABRin the past three years. Recently, some other organizations started to do ABR, but these are still modest.
- Confirmed cases of hearing impairment have complete data and addresses in ASDC, but controls are not adequately. The researcher had to get the contact information from NECC and to lesser extent from UNRWA and through personal connection. This difficultly affects the geographic distribution of controls where most of them were living in Gaza and North.

Findings and Analysis

The results of this study are concluded from the responses of families to the structured questionnaire as reported by caregivers of children with hearing impairment (cases) and caregivers of children without hearing impairment (controls). This chapter provides an overview of demographic characteristics of the population surveyed followed by a description of the family history including consanguinity. The subsequent sections illustrate risk factors related to maternal, fetal, childhood and environmental conditions in addition to the availability, access and utilization of health services. For efficiency purposes, wherever applicable, descriptive and analytical findings were presented together.

4.1 Sociodemographic characteristics of study population:

The population surveyed consists of 338 children (169 cases and 169 controls) distributed across GGs with 14.8% were living in the North Gaza, 62.7% in Gaza, 6.8% in Dier-Albalah, 8% in Khanyonis and 7.7% in Rafah governorate (Figure 2). This distribution of the sample is different from the universal population, possibly attributed to the absence of universal screening program that covers the entire of the population and hence the detection of hearing impairment was selective to the sites at which screening was conducted at. Controls were selected from NGOs, MOH and UNRWA wherever the selection criteria are met and contact details are available.

With regard to gender, 54.1% were males and 45.9% females (Figure 3). This is congruent with the literature which shows that the prevalence of disability is more among males; including hearing impairment, MOH report showed that 54.6% of PWDs in Gaza were males and 45.4 were females (MOH, 2015).The mean age of cases and controls, at the time of data collection, is very close at 33.36 and 33.22 months respectively which gives a signal that the matching of age among cases and controls was appropriate. The sociodemographic characteristics of study population are shown in table 1.

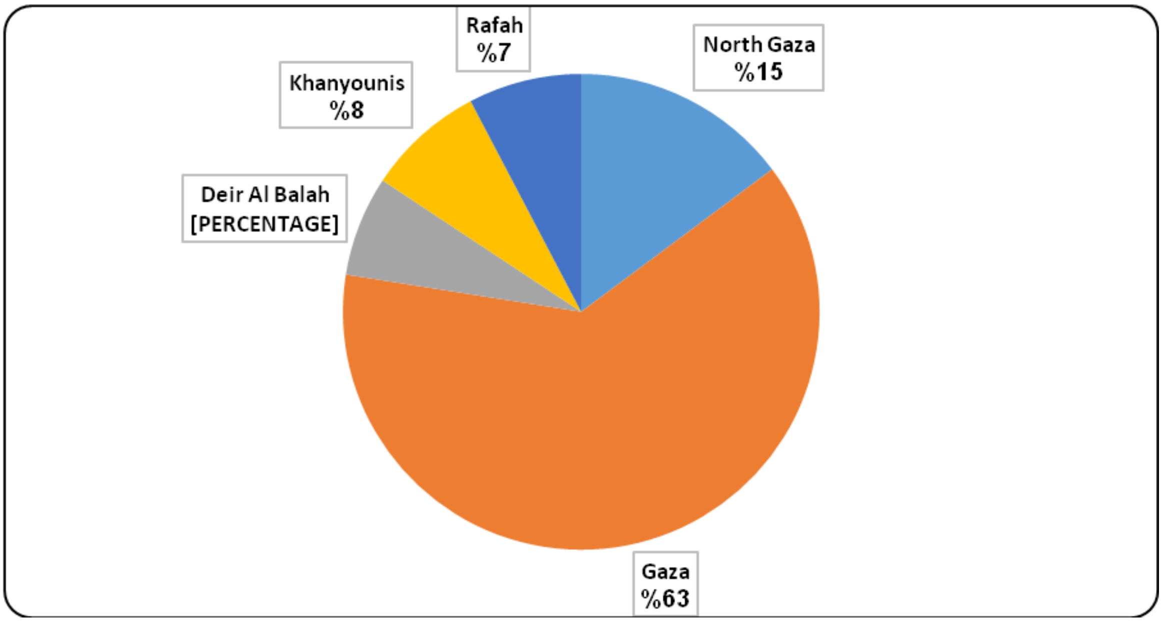

Figure 2 :Distribution of study population by governorates

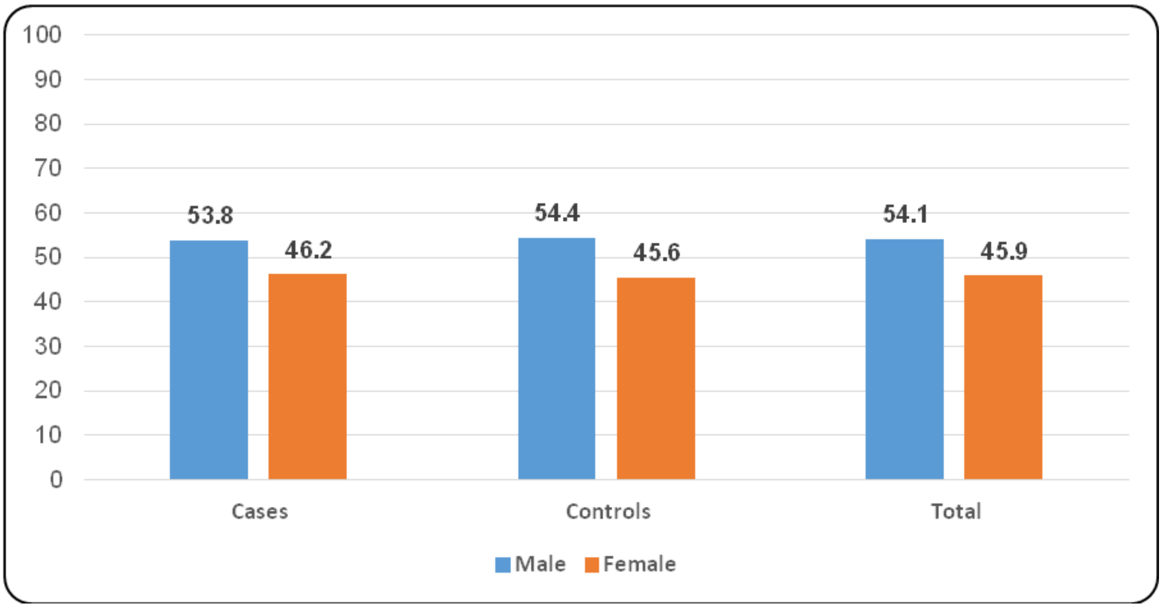

Figure 3 : Distribution of study population by gender

Table 1: Distribution of participants (cases and controls) by demographic characteristics (N=338)

Independent variable	Category	Case (169)		Control (169)		Total (338)		Chi	Sig.
		No	%	No	%	No	%		
Gender of the child	Male	91	53.8	92	54.4	183	54.1		
	Female	78	46.2	77	45.6	155	45.9		
Child age in months	≤ 12 months	7	4.1	7	4.1	14	4.1		
	13-24	31	18.3	32	18.9	63	18.6		
	25-36	43	25.4	57	33.7	100	29.6		
	≥ 37	88	52.1	73	43.2	161	47.6		
	Mean	33.36		33.22		33.29			
	Median	37		35		36			
Governorates	North Gaza	34	20.1	16	9.5	50	14.8		
	Gaza	73	43.2	139	82.2	212	62.7		
	Dier Al-Balah	21	12.4	2	1.2	23	6.8		
	Khan Younis	23	13.6	4	2.4	27	8.0		
	Rafah	18	10.7	8	4.7	26	7.7		
Type of locality	Urban	94	55.6	155	91.7	249	73.7	57.79	0.001*
	Rural	33	19.5	9	5.3	42	12.4		
	Camps	42	24.9	5	3	47	13.9		
Refugee status	Refugee	112	66.3	92	54.4	204	60.4	4.95	0.034*
	Non-refugee	57	33.7	77	45.6	134	39.6		
Type of family	Nuclear	114	67.5	119	70.4	233	68.9	0.35	0.560
	Extended	55	32.5	50	29.6	105	31.1		
Family size	≤ 5	73	43.2	77	51.3	150	44.4	0.302	0.860
	6-8	53	31.4	53	31.4	106	31.4		
	≥ 9	43	25.4	39	23.1	82	24.3		
	Mean	7.53		6.76		7.14		t=1.76	0.079
	Median	6		6		6			
Current mother's age (N=337)	≤27	92	54.8	82	48.5	174	51.6	1.314	0.276
	≥28	76	45.2	87	51.5	163	48.4		
	Mean	27.95		28.88		28.42		t=1.57	0.120
	Median	27		28		27			
Mother's marital age	≤19	91	53.8	84	55.6	185	54.7	t=0.11	0.827
	≥20	78	46.2	75	44.4	153	45.3		
	Mean	19.69		19.65		19.67		t=0.10	0.920
	Median	19		19		19			
Mother's age at delivery of the concerned child	≤24	84	49.7	79	46.7	163	48.2	0.296	0.663
	≥25	85	50.3	90	53.3	175	51.8		
	Mean	25.4		26.21		25.81		t=1.41	0.160
	Median	25		25		25			
Current father's age (N=337)	≤30	83	49.1	75	44.6	185	46.9	0.676	0.445
	≥31	86	50.9	93	55.4	179	53.1		
	Mean	31.98		33.32		32.65		t=1.96	0.051
	Median	31		32		31			
Mother's level of education attained	Preparatory or less	66	39.1	56	33.1	122	36.1	1.982	0.371
	Secondary	65	38.5	65	38.5	130	38.5		
	Diploma or more	38	22.5	48	28.4	86	25.4		
Father's level of education attained	Preparatory or less	52	30.8	62	36.7	114	33.7	1.504	0.471
	Secondary	58	34.3	50	29.6	108	32		
	Diploma or more	59	34.9	57	33.7	116	34.3		

*statistical significant

Of the 169 cases, 66.3% were refugees and 33.7% were non-refugees compared to 54.4% and 45.6% among the controls respectively. More cases were reported among refugees than non-refugees and the differences between the groups werestatistically significant (Chi 4.95 p value 0.034, OR 1.645 CI 1.059-2.553). This result could be related to the better utilization of screening at UNRWA clinics rather than a real difference between refugees and non-refugees, again the absence of universal screening program could affect the distribution of cases and controls.

Of the total surveyed population, 73.7% were living in urban areas, 12.4% in rural areas and 13.9% in camps. This percent is comparable to population distribution according to PCBS report in 2016 (PCPS, 2016b) which shows that 73.9%, 16.6% and 9.5% of population resides in Urban, rural and camps respectively. It was noticed that more cases were residing in rural and camps areas compared to controls. Table 1 shows that of cases 19.5% were living in rural areas, 55.6% in urban area and 24.9% in camps compared to 5.3%, 91.7% and 3% of controls respectively. The differences between cases and controls according to the type of locality is statistically significant (chi square is 57.79, p value is 0.001). The relationship between type of locality and hearing impairment could be explained by exposure to environmental hazards where rural areas are mostly located near the borders and subject to invasions, bombardments and may be environmental pollution like exposure to pesticides. Camps are more crowded.Also, social and cultural contexts at these areas are different.The literature supports this finding, in one survey conducted on Chinese children living in rural areas were more affected than those living in urban areas (Yun et al, 2017). This relationship found in this can be used in defining target population for screening activity if universal screening is not available. Mobile campaigns or clinic for hearing screening should be directed to borderline, remote and rural areas, also camps should be focus on. Generally speaking, this area needs more investigations and study as one limitation of this study is the unequal distribution of cases and controls over all areas due to lack of universal screening services which could provide more space for fairly selecting cases and controls from different areas.

The proportions of cases who were living in nuclear and extended was 67.5% and 32.5% respectively compared to 70.4% and 29.6% of controls, indicating that children with hearing impairment are prominently belong to extended families–although not statistically significant –this could be because of intra-familial marriages which is common among extended families. The percent of nuclear families in the total surveyed sample is 68.9%

while extended families constituted 31.1%. The PCBS report shows that nuclear family constitutes 84.7% of all families in Gaza (PCBS, 2016). The lower percent of nuclear families among the cases in comparison with the general population could be explained by deteriorating socio-economic conditions and inability of spouses to have separate houses.

The mean family size of the entire study population is 7.14 members which is higher than what is stated by the PCBS (5.6) (PCBS, 2018). This difference is probably due to the larger mean family member of the extended families. Although the mean family size was higher among the cases (7.53) than controls (6.76), the differences didn’t reach statistical significance level (P value 0.079).

The current average of mothers’ age in the study at the time of data collection was28.42 years. There were no statistically significant differences between mean mother’s ages of cases (27.95 years) compared to controls (28.88 years) (p value 0.12). The mean marital age is 19.69 years for cases and 19.65 years for controls, the median marital age was the same for cases and controls and equal to 19 years which is the same as what is reported by PCBS report (2018). The percent of mothers of cases who were married before reaching 20 years was 53.8% compared to 55% of controls, but the differences were not statistically significant (P value 0.827). Moreover, the mean age of mother at delivery of the concerned child was 25.81 years while it was 26.21 for the mothers of the controls. The median age at delivery of the concerned child were equal in cases and controls mothers and equal 25 years. Mothers’ age at delivery didn’t show statistically significant differences between the cases and the controls (p value 0.160). Current fathers’ age means were similar between cases and controls as 49.1% of fathers of cases aged less than 31 years compared to 44.6% of controls. Also, there was similarity among fathers’ ages among cases and controls in the other age categories.

Mothers of controls were more educated than the mothers of cases as 28.4% of them had attained diploma or higher certificate while 22.5% of their counterparts’ (mothers of cases) had attained the same level, still the differences were not statistically significant (p value 0.371). The percent of mothers who attained diploma and more in the total surveyed population was 25.4% which is higher than what is stated in the PCBS report (21.3%) (PCBS, 2017). Fathers’ level of education didn’t vary among cases versus controls, as table 1 shows the percent of fathers of cases who attained diploma or more was 34.9% compared to 33.7% of controls fathers (Chi 1.504, p value 0.471). WHO suggests that the prevalence of hearing loss in children, decreases linearly as parent's literacy rate increases (WHO, 2012a).This contradictory could be explained by high level of literacy in Gaza. It was noticed that the percent of fathers who attained diploma degree or more was 34.3% which is much higher than what is stated in PCBS report. The report showed the percent as 22.5% (PCBS, 2017).

4.2 Economic status of study population

The mothers of controls were more employed compared to cases as (6.5% of controls versus 1.2% of cases) (OR 3.877 CI 1.062-14.15). This significant relationship could be explained by the assumption that working mothers may enjoy better economic situation and also, they might be more exposed or oriented to appropriate healthy practices.

Table 2 : Distribution of participants (cases and controls) by Literacy, employment status and economic condition (N=338)

Independent variable	Category	Case (169)		Control (169)		Total (338)		chi	Sig.
		No	%	No	%	No	%		
Mother's current employment (N=337)	Unemployed	166	98.8	158	93.5	324	96.1	NA#	0.025*
	Employed	2	1.2	11	6.5	13	3.9		
Father's current employment	Unemployed	56	33.1	65	38.5	121	35.8	1.043	0.364
	Employed	113	66.9	104	61.5	217	64.2		
Father's type of work	Vocational or trade	114	76	110	68.8	224	72.3	2.030	0.165
	Service provision	36	24	50	31.3	86	27.7		
Monthly family income (N=335)	≤ 500 NIS	62	36.9	66	39.5	128	38.2	1.213	0.545
	501-1000 NIS	71	42.3	61	36.5	132	39.4		
	> 1000 NIS	35	20.8	40	24	75	22.4		
	Mean	781.37		832.93		807.07		t=0.75	0.450
	Median	700		700		700			
Monthly family expenditure (N=335)	≤ 800 NIS	51	30.5	33	19.6	84	25.1	5.869	0.053
	801-1400 NIS	58	34.7	61	36.3	119	35.5		
	> 1400 NIS	58	34.7	74	44	132	39.4		
	Mean	1239.22		1313.27		1276.36		t= 0.99	0.330
	Median	1000		1150		1000			
Income expenditure gap	Mean	-462.75		-479.22		-471.00		t=6.29	0.774
	Median	-400		-400		-400			
Receiving social assistance (N=335)	Yes	96	56.8	60	36.1	156	46.6	14.37	0.001*
	No	73	43.2	106	63.9	179	53.4		

*statistical significant, # Fisher's Exact Test was used

While the percent of unemployed or economically inactive women in Gaza was 93.7% (PCBS, 2018a), in this study the percent of mother's unemployment was higher (96.1%) and could be explained by the constant progressive deteriorating conditions in Gaza resulting from blockade. Unemployment of fathers of cases and controls was 35.8%

(33.1% for cases and 38.5% for controls) which is higher than PCBS data in 2018 where unemployment percent was 31.6% (PCBS, 2018a).

With regard to the type of work, 76% of fathers of cases compared to 68.8% of controls were working as unskilled workers, still the difference is not statistically significant (p value 0.165). This finding is inconsistent with the literature which indicates that there is a relationship between hearing loss in children and the type of occupation of the head of the household with lower classes had a significantly higher risk of births with sensorineural hearing loss, particularly among families of manual workers (Vasconcellos et al, 2014). The main cause of this inconsistency with the literature might be the small size sample and the percent of unemployment across board. Also, the number of jobs available is much less than and usually similar in nature while in industrial countries there is greater variations in job and occupations.

Findings of this study show that there were differences between cases and controls with regard to monthly family income and expenditure but the differences are not statistically significant. The mean family income of cases and controls were 781.37 and 832.93 NIS respectively. The average monthly expenditure was 1239.22 and 1313.27 NIS for cases and controls respectively, for more details about family monthly income see Table 2. The average monthly family expenditure of the total surveyed population was 1276.36 NIS (255 JD), this number is less than the average monthly expenditure resulted from The Palestinian Expenditure and Consumption Survey in 2017 which was 556 JD (PCBS, 2018b). This difference is properly due to underreporting of respondents to their expenditure and also to the differences in the data collection instruments. The mean income-expenditure gap was -462.75 for cases and -479.22 for controls, with no statistically significant differences (p value 0.774).

Interestingly, there is a statistically significant difference between cases and controls regarding receiving social assistance as 56.8% of cases admitted that they are receiving social assistance compared to 36.1% of controls (OR 2.323 CI 1.497-3.605). A possible explanation for that might be related to the targeting of the social assistance programs where disability is usually considered when assessing the economic status of the family; it is one of the 34 indicators that are used in the Proxy Means Test Formula Findings of this research fit with the literature, as a large systemic review study shows that low-income families had a statistically significant increased prevalence of high frequency hearing loss as compared with children of families with high income (Vasconcellos et al, 2014). The National Health Interview Survey done in U.S.A, showed that families of hearing-impaired children live below the poverty level (P < .01) (Boss et al, 2011). Families with poor socioeconomic levels, or families in need for social services should be targeted by health education, counselling regarding risk factor, signs and symptoms of hearing impairment and even supported toward screening and early detection of hearing impairment.

4.3 Housing conditions of study population

Although housing conditions were globally reported as significant risk factors for hearing impairment, in this study it wasn't as both cases and controls had experienced almost the same circumstances. More than two thirds of cases (87%) and controls (83.4%) were living in separate houses or apartment while 12.4% and 16.6% were living in separate room or caravans respectively with no significant differences (P value 0.354). Table 3 shows the details of housing conditions of both cases and controls.

Table 3 : Distribution of responses (cases and controls) about Housing conditions(N=338)

Independent variable	Category	Case (169)		Control (169)		Total (338)		Chi	Sig.
		No	%	No	%	No	%		
Kind of dwelling	Separate house, apartment	148	87.6	141	83.4	289	85.5	1.7	0.354
	Separate room or caravans	21	12.4	28	16.6	49	14.5		
No of bedrooms at HH	1-2 bed rooms	88	52.1	102	60.4	190	56.2	2.356	0.154
	≥3 bed room	81	47.9	67	39.6	148	43.8		
	Mean	2.48		2.42		2.45			
	Median	2		2		2			
Crowding index	Mean	3.60		3.08		3.34		1.630	0.105
	Median	2.50		2.67		2.5			
Type of occupancy	Owned or family home	157	92.9	163	96.4	320	94.7	2.113	0.225
	Rented or other	12	7.1	6	3.6	18	5.3		
Source of drinking water	Purchased gallons or water from tanker	158	93.5	165	97.6	323	95.6	3.418	0.110
	Other sources	11	6.5	4	2.4	15	4.4		
Source of water for domestic use	Public water network	161	95.3	166	98.2	327	96.7	2.349	0.219
	Other	8	4.7	3	1.2	11	3.3		

As Table 3 shows, the number of bedrooms is different between cases and controls where 52.1% and 60.4% of cases and controls respectively have had one or two bed rooms while 47.9% and 39.6% have more than three bed rooms but the difference is not statistically significant (p value 0.154). The average number of bedrooms is 2.4 for both cases and controls which is less than the PCBS (2017) reported number (3.4). Crowding index, which is calculated by dividing the family size by number of bed rooms, was 3.6 for cases and 3.08 for controls with no significant difference (p value 0.105). The responses showed that 94.7% of families were living in houses owned by them or their larger family members. This is much higher than what is being reported in 2018 by the PCBS (83.22%) (PCBS, 2018a).

Most people in the Gaza governorates reported using purchased water from tankers or purchased gallons as the main sources for drinking water. Responses from the respondents of both cases and controls were approximately similar as 93.5% and 97.6% respectively depend on the mentioned above sources. The majority of houses in this study (96.7%) are connected to public water network and use it as a source of water for domestic use where 95.3% and 98.2% of cases and controls use public water network for domestic use (p value 0.219). From the above, no statistically significant variations were noticed between cases and control regarding housing conditions. Universal screening should be implemented if possible and affordable regardless of the housing conditions of people**.**

4.4 Issues around diagnosis of children with hearing impairment

Early diagnosis is very crucial in the prognosis and future potential of children with hearing impairment. This study shows that the mean age of diagnosis of cases was 10.95 months and the median is 10 months. As figure 3 shows, the majority of children were diagnosed before their first birthday (77.5%), 19.5% of cases were diagnosed in the second year and the remaining 3% are diagnosed in their third year. Parent suspicion is very important and it usually preceded the diagnosis. Parents noticed a problem in hearing among their children in their first year in most of cases (83.4%). Details are showed in table 4.

It worthy to mention that checking the record of Atfaluna showed that the mean age of diagnosis is 14.6 months and the median is 13.2 months. This discrepancy between parents' perception and reality reflect that families are not fully aware of impact of delayed diagnosis and this emphasizes the need of more counselling and health education regarding the necessity of early diagnosis for better outcome. In U.S.A, prior to the universal screening, the average age at which children were found to have a hearing loss is 2-3 years, children with mild-to-moderate hearing loss were often not identified until 4 years of age (Delaney, 2016).

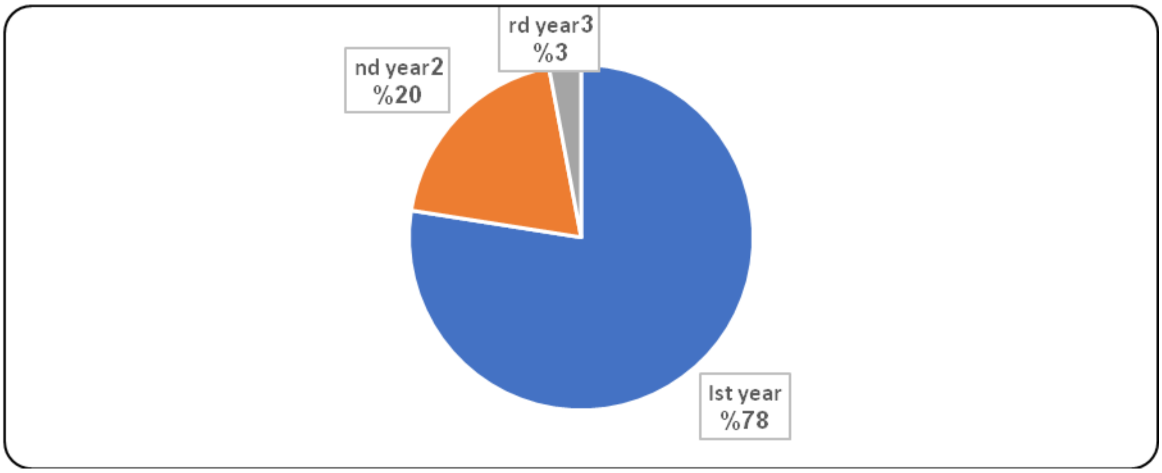

Figure 4: Distribution of cases according to the age of diagnosis

Table 4 : Distribution of children with hearing impairment (cases only) by variables related to diagnosis(N=169)

Items	Category	No (169)	%
Age at diagnosis in months	≤ 12 months	131	77.5
	13-24 months	33	19.5
	≥ 25 months	5	3
	Mean 10.95, Median 10		
Age in months, at which parents felt that the child has a problem in hearing	≤ 12 months	141	83.4
	13-24 months	26	15.4
	≥ 25 months	2	1.2
	Mean 8.83 Median 7		
Receiving information that the child is having congenital hearing impairment	Yes	34	20.1%
	No	135	79.9%
Knowing the type of inheritance	Autosomal dominant	5	14.8%
	Autosomal recessive	6	17.6%
	No, don't know	23	67.6%

Despite that responses from cases' families show that there is a positive family history in 35.5%, only 20.1% of cases had been informed that their hearing impairment could be inherited. Most of time (67.6%) cases families have no information on the type of inheritance, 5 cases admitted the occurrence of autosomal dominant inheritance and 6 cases of autosomal recessive. This is a prominent gap in patient diagnosis and education which could affect the re-occurrence of hearing impairments in other sibling or generation.

4.5 Family history

Findings of this study show that the proportion of consanguinity is 55% of all population surveyed. The percent of first- degree marriage is 39.9% of all the respondents, higher than what was reported by the PCBS which indicates that the percentage of women (aged 15-49) married to first-degree relatives was 30.1% in the Gaza Strip (PCBS, 2012). Consanguinity marriages were more prominent among the families of the cases (71%), while it was 39.1% among their counterparts in the controls group. The variations among the two groups in consanguinity are strongly statistically significant and risk of hearing impairment (Chi 34.86 p value 0.001, OR 3.822 CI 2.428-6.017). Consanguinity increases the risk of hearing impairment more than three folds. Details are showed in table 5

Table 5: Distribution of participants (cases and controls) by consanguinity and family history of congenital anomalies(N=338)

Independent variable		Case (169)		Control (169)		Total (338)		Chi	Sig.
		No	%	No	%	No	%		
Consanguinitymarriage	Yes	120	71	66	39.1	186	55	34.86	0.001*
	No	49	29	103	60.9	152	45		
Classification of degree of consanguinity	Double 1st cousin	43	35.8	23	34.8	66	35.5		
	1st cousin	45	37.5	24	36.4	69	37.1		
	2nd cousin	12	10	6	9.1	18	9.7		
	Same family	20	16.7	13	19.7	33	17.7		
Family history of hearing impairment	Yes	60	35.5	10	5.9	70	20.7	45.04	0.001*
	No	109	64.5	159	94.1	268	79.3		
Family history of other congenital diseases	Yes	39	23.1	31	18.3	70	20.7	1.15	0.174
	No	130	76.9	138	81.7	268	79.3		
Family member having hearing impairment (N=60)	Father					10	14.3%		
	Mother					1	1.4%		
	Sibling					31	44.3%		
	Other family member					28	40%		
Age of diagnosis in years of family member with hearing impairment	Mean 2.7 year Median 1.7 year Minimum 1 month Maximum 17 years								

*statistical significant

This result that consanguinity is a risk factor has been supported by different studies which all stress on the importance of consanguinity as a risk factor for hearing impairment in children. A case control study conducted in India showed that in the case group, 48% of the children had parents with consanguinity. In the control group, 28% of the children had parents with consanguinity (Shrikrishna & Deepa, 2016). A similar result was noticed in

Qatar, where parental consanguinity was more common among affected individuals with hearing impairment as compared with unaffected ones (Girotto et al, 2014).

The presence of family history of hearing impairment was statistically significantly more prominent among cases more than controls. Cases shows a positive family history in 35.8% of responses compared to only 5.9% of controls (Chi 45.04 p 0.001, OR 8.752 CI 4.293-17.846). The risk of hearing impairment in families with positive family history of hearing impairment is almost 9 times the risk in families with no family history, this risky group should be counselled even before marriage, during preconception care and should be focused on in any screening program. A survey was done in state of Iowa shows congruent findings as family history demonstrates a significant relationship with congenital hearing loss (OR = 9.463, p < .001) and with delayed-onset hearing loss (OR = 8.169, p < .001) (Dumanch et al, 2017). Another study conducted in India shows the same result where in the case group, 28% children had a family history of hearing loss and in the control group; none had a family history of hearing loss (Shrikrishna & Deepa, 2016). The study fails to show an association between family history of other congenital diseases and hearing impairment in children, Cases had 23.1% of positive response, while controls had 18.3% (p value 0.283)

As table 5 shows, 70 families reported positive family history. Siblings are affected in 44.3% of responses, fathers in 14.3%, mothers in 1.4% and the remaining 40% other family members like cousin, aunt, uncle or others. The mean age of diagnosis of hearing impairment for family member other than this concerned child is 2.7 year which is older than the mean of diagnosis of study population which is 10.95 months which reflects that the history of hearing impairment encourages early screening and diagnosis and/or improvement in the early detection in the country.

4.6 Medical and maternal history

Responses from mothers of cases and controls show that the presence of chronic diseases of mothers didn’t show statistically significant differences between the two groups. The literature suggests that children of diabetic mothers are more prone to hearing impairment (Wang , Martínez, & Graham, 2002). The percent of mothers of cases who had chronic diseases is 11.8% compared to 10.7% of controls (p value 0.864).

Table 6: Distribution of participants (cases and controls) by maternal medical and obstetric history (N=338)

Independent variable		Case (169)		Control (169)		Total (338)		Chi	Sig.
		No	%	No	%	No	%		
History of maternal chronic diseases	Yes	20	11.8	18	10.7	38	11.2	0.119	0.864
	No	149	88.2	151	89.3	300	88.8		
Experiencing complications during pregnancy	Yes	66	39.1	60	35.5	126	37.3	0.456	0.574
	No	103	60.9	109	64.5	212	62.7		
Experiencing pregnancy induced hypertension	Yes	37	21.9	18	10.7	55	16.3	7.839	0.004*
	No	132	78.1	151	89.3	283	83.7		
Experiencing high grade fever during pregnancy	Yes	19	11.2	4	2.4	23	6.8	NA#	0.001*
	No	150	88.8	165	97.6	315	93.2		
Ingestion of medications during pregnancy	Yes	105	62.1	71	42	176	52.1	13.704	0.000*
	No	64	37.9	98	58	162	47.9		
Aspirin intake during pregnancy	Yes	23	13.6	11	6.5	34	10.1	4.709	0.023*
	No	146	86.4	158	93.5	304	89.9		
Dying hair during pregnancy	Yes	28	16.6	24	14.2	52	15.4	0.364	0.651
	No	141	83.4	145	85.8	286	84.6		
Maternal exposure to imaging during pregnancy	Yes	25	14.8	7	4.1	32	9.5	11.184	0.001*
	No	144	85.2	162	95.9	306	90.5		
Maternal exposure to trauma during pregnancy	Yes	26	15.4	10	5.9	36	10.7	7.959	0.004*
	No	143	84.6	159	94.1	302	89.3		
Exposure to a close bombing or explosion	Yes	69	40.8	55	32.5	124	36.7	2.497	0.142
	No	100	59.2	114	67.5	214	63.3		
Intake of Folic Acid before pregnancy	Yes	99	58.6	81	47.9	180	53.3	3.851	0.640
	No	70	41.4	88	52.1	158	46.7		
Duration of FA intake before pregnancy	< 3 months	63	63.6	35	43.2	98	54.1	7.494	0.007*
	≥3 months	36	36.4	46	56.8	83	45.9		
Intake of supplements during pregnancy	Yes	155	91.7	163	96.4	318	94.1	3.401	0.105
	No	14	8.3	6	3.6	20	5.9		
Folic acid during pregnancy	Yes	143	84.6	141	83.4	284	84	0.088	0.882
	No	26	15.4	28	16.6	54	16		
trimester of intake of Folic acid (N=273)	1st	113	85	136	97.1	249	91.2	NA#	0.000*
	2nd or 3rd	20	15	4	2.9	24	8.8		
Intake of Iron supplement during pregnancy	Yes	108	63.9	135	79.9	243	71.9	10.674	0.002*
	No	61	36.1	34	20.1	95	28.1		
Duration of iron intake during pregnancy (N= 182)	≤ 3 months	36	57.1	31	46.3	67	36.8	17.12	0.000*
	≥ 4 months	27	42.9	88	73.9	115	63.2		

* Significant relationship, # Fisher Exact Test was used

The most prevalent chronic disease is hypertension (3.3%) followed by asthma (2.4%) and diabetes mellitus (1.2%). This inconsistency with the literature could be explained by the fact that the sample in this study contained four mothers only with diabetes mellitus and a larger sample is needed to study this factor.

Table 6 shows complications experienced during pregnancy, were almost the same proportions were reported by cases and controls population. Although complications were slightly higher among cases than controls, the differences didn't reach statistical significance level (p value 0.574). Mothers of cases who developed any complications during pregnancy constituted 39.1% while controls constituted 35.5%. Interestingly, when studying each complication alone, Pregnancy Induced Hypertension (PIH) rate was higher among the mothers of cases than among controls. Mothers of cases who reported experiencing PIH were 21.9% but only 10.7% of controls had PIH (Chi 7.839 p value 0.004, OR 2.351 CI 1.278-4.327). PIH is a known cause of low birth weight which itself is a reason for neonatal NICU admission. Admission to NICU was suggested as a risk factor for hearing impairment in children which will be discussed in details in the next section. In total, 55 mothers developed PIH as they reported, 27.3% of them had delivered babies whose weight is less than 2500 gram compared to only 9.2% of who didn't develop PIH (chi 14.131 p value 0.001 OR 3.707 CI 1.809-7.596). Mothers with PIH are more prone to complications during delivery which could explain the relationship with hearing impairment (Annex 6, table 11). As table 6 shows, experiencing high grade fever (more than 38.5 c°) as a complication during pregnancy was found to be associated with increasing risk of hearing impairment in children. The percent of mothers of cases who suffered from fever was 11.2% compared to 2.4% of controls (p value 0.001, OR 5.225 CI 1.738-15.707). Some viral infections such as CMV are known to be associated with hearing loss. These infections carry the highest risk of causing hearing loss if the mother has the illness during pregnancy or passes the infection to her baby during the birth process (Smith et al 2014). It was difficult to identify specific viruses as this need more advanced lab research which is not the scope of this research but this could be a space for more in-depth investigation.

Medications use during pregnancy has been alwaysdebated. In this research medications use was studied and showed a significant relationship with hearing impairment. Mothers of cases reported much more ingestion of medications compared to controls. The percent of mothers of cases who reported the use of different medications was 62.1% compared to

42% of controls (Chi 13.704 p value 0.000, OR 2.265 CI 1.465-3.501). The same relationships were found in a study in Egypt which showed a significant relationship between hearing impairment and pregnancy drug misuse (OR 0.23 CI 0.07- 0.71 P value 0.006)(Taha & Pratt, 2010). The most prominent medications used by mothers in this research is Aspirin, with 13.6% of mothers of cases compared to 6.5% of controls reported using it. The difference in the proportion of using Aspirin was statistically significant (chi 4.709 p value 0.023, OR 2.263 CI 1.066-4.804). It could be claimed that Aspirin is being used with more frequency in PIH cases, cross tabulation was done and showed that the percent of PIH cases who used Aspirin is 29.1% compared to 6.4% of pregnant mother who didn't develop PIH (Annex 6 table 11). To study the effect of Aspirin in fetal development and hearing, an experimental study with large sample is needed. In one study conducted in Michigan, it was claimed that mother who used aspirin have more risk to have children with cerebral palsy, the possibility that aspirin use in pregnancy could lead to perinatal brain damage cannot be excluded (Tyler et al., 2012).

The researcher didn't notice differences among mothers of cases and controls regarding dying or coloring hair during pregnancy. The percent of mothers of cases who colored their hair is 16.6% compared to 14.2% of mothers of controls (p value 0.651). Possible adverse impacts such as congenital malformations and childhood cancers of fetuses that may be caused by hair dye use during pregnancy have been debated for long years. A case-controlled study found that cases only delivered small for gestational agebabies. The study suggested that the reliability of using hair dye during pregnancy has still been controversial in terms of both teratological and carcinogenic effects (Api & fien, 2014).

Maternal exposure to imaging showed different proportions as reported by the mothers of cases versus controls. The percent of mothers who had been exposed to imaging during pregnancy was 14.8% and 4.1% in cases and controls respectively (chi 11.184 p value 0.001, OR 4.018 CI 1.687-9.568). Maternal exposure to imaging should be restricted and risk -benefit should be weighted, and if imaging is necessary, all available precautions should be taken inconsideration. It was not applicable to study each type of imaging alone as the total number is small. One study conducted in Canada showed that exposed mother to MRI compared with non-exposed showed no associated with increased risk of harm to the fetus or in early childhood (Ray et al, 2016). In this research, the most type of imaging used in pregnancy was CT scan followed by X-rays (annex 4).

The percentage of mothers of cases suffered from trauma during pregnancy was 15.4% compared to 5.9% of controls (Chi 7.959 p value 0.004, OR 2.891 CI 1.347-6.203). A study conducted in China concluded that trauma during pregnancy is associated with unfavorable maternal outcomes mainly prematurity (Han-Tsung et al, 2012). The relationships between trauma during pregnancy and preterm labor were not supported in this study. One explanation could be that the total numbers of mother who admitted exposure to trauma is 36 which is small. Large sample is needed to study this area. Causes of maternal trauma were different, the majority were caused by falling down followed by bombing or explosions as showed in Figure 5. Maternal history of trauma should increase the suspicion of health care provider of unfavorable pregnancy outcome, and hence this could be alarming for close follow up.

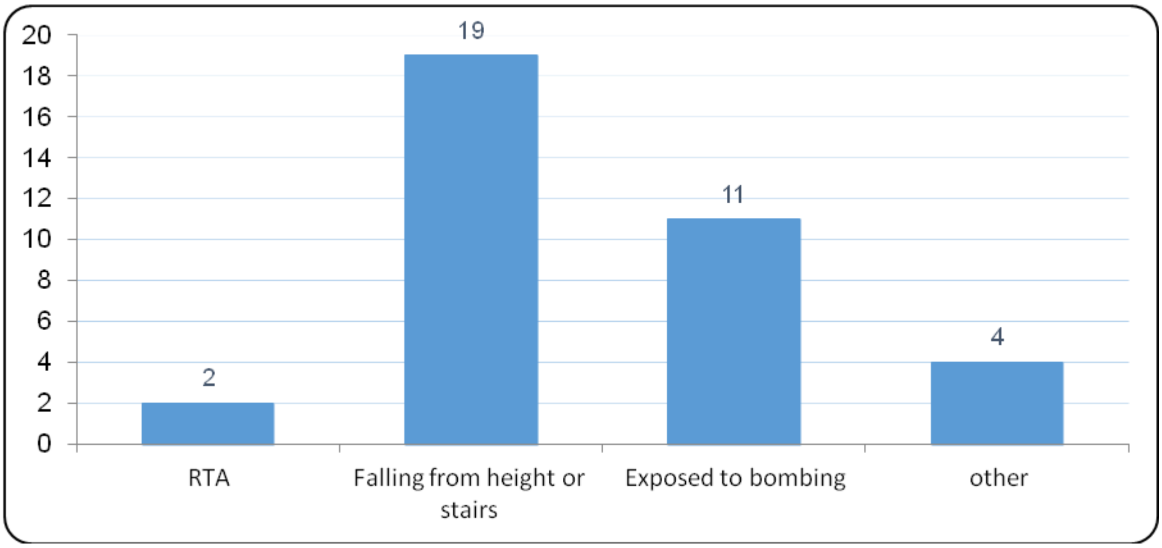

Figure 5: Causes of trauma during pregnancy

Exposure to a nearby bombing was higher among cases than controls, but not reaching statistically significant level. The percent of mothers of cases who were exposed to bombing was 40.8% compared to 32.5% of controls (p 0.142). Results of different studies suggest that exposure to excessive noise during pregnancy may result in high-frequency hearing loss in newborns and may be associated with prematurity and intrauterine growth retardation (CDC, 2017b). The noise level of explosion and possible toxic material couldn't be assessed in this study; hence the effect was not clear. A separate study of the effect of explosion on pregnancy outcome is needed, especially in the context of Gaza governorates where pregnant women are exposed to frequent bombing and explosions.

In this study, the ingestion of Folic Acid before pregnancy was seen in 53% of the total sample, with 58% and 47.9% among mothers of cases and controls respectively (p 0.640), but the main difference was in the duration of folic acid, in 56.8% of mothers of controls, the duration was three months and more compared to 37% of cases (Chi 7.494 p value 0.007, OR 2.30 CI 1.261-4.194). In a study conducted in Egypt, the serum levels of folate and vitamin-B 12 are decreased in children diagnosed to have sensorineural hearing loss (Taha et al, 2014). The role of folic acid in the development of nervous system is well known especially early in pregnancy. In this research the early use of Folic acid in first trimester shows statistically significant relationships with hearing impairment. Mothers of controls (who could remember) mentioned early use of Folic acid in 97.1% compared to 85% of cases (p value 0.000, OR0.166 CI 0.055-0.5), that is mothers who had used Folic acid in the first trimester had a lower risk of hearing impairment by more than 80% compared to mothers who had folic acid after the first trimester. Folic acid supplementation after the first month of pregnancy doesn’t prevent neural tube defects. However, it will contribute to other aspects of maternal and fetal health (WHO, 2012b). Supplementation of folic acid for at least 3 months before and early in pregnancy should be adopted by all health care provider as one way of improving pregnancy outcome.

Iron supplementation and duration of its use showed statistically significant differences between cases and controls. Mothers of cases reported that 63.9% of them used iron tablets compared to 79.9% of controls (Chi 10.674, p value 0.002, OR 0.446 CI 0.273-0.728),having iron supplements during pregnancy decrease the risk of hearing impairment by 55.4%. Mothers who could remember the duration mentioned that 42.9% and 73.9% of mothers of cases and controls respectively used iron tablets for 4 months and more (Chi 17.12 p value 0.000, OR 3.785 CI 1.985-7.217). A prospective cohort study was performed in India showed that latent iron deficiency was found to be associated with abnormal auditory neural maturation in infants at ≥34 weeks gestational age ($P < 0.05$) (Choudhury et al, 2015).

It can be observed from the above analysis that most, of maternal factors affect the risk of hearing impairment indirectly by increasing the risk of prematurity and low birth weight like PIH and trauma. The other factors like folic acid and iron supplementation could affect the development of auditory system. These results highlight the importance of antenatal care to optimize the health condition of pregnant women and her newborn in order to prevent or decrease the incidence of prematurity and hence hearing impairment.

4.7 Fetal and Childhood history

Responses from mothers of cases and controls show that the order of concern child didn't show statistically significant differences between the two groups (see table). In one study conducted in Egypt child birth order > 3 associated with hearing impairment (p value.001) (Taha & Pratt, 2010).

The birth interval between the concerned child and the preceding child was higher in controls than cases, but not reaching significant level. Proportion of cases who had birth interval ≤ 24 months was 72.7% and the rest 27.3% had birth interval of ≥ 24 months. On the other hand, controls constituted 61.21% and 38.8% respectively (p value 0.06). Even the result is not significant, it could give a clue that short birth interval could be linked to poor pregnancy outcome. Also, many factors, which could affect hearing ability, like poverty, and education could cause short birth interval (Courbage, Abu Hamad, & Zagha, 2016)

Table 7: Distribution of participants (cases and controls) by fetal, neonatal and childhood history and factors (N=338)

Variable		Case (169)		Control (169)		Total (338)		Chi square	Sig.
		No	%	No	%	No	%		
Order of the concerned child	First one	41	24.3	48	28.4	89	26.3	1.801	0.625
	2nd	43	25.4	43	25.4	86	25.4		
	3rd	38	22.5	29	17.2	67	19.8		
	Fourth and more	47	27.8	49	29	96	28.4		
Birth interval	≤ 24 months	93	72.7	74	61.2	167	49.4	3.72	0.060
	≥ 25 months	35	27.3	47	38.8	82	24.3		
	Mean	27.06		31.37		29.16		t=1.94	0.053
	Median	24		24		24			
Mode of delivery	Normal/vaginal	128	75.7	145	85.8	273	80.8	5.505	0.027*
	Instrumental or CS	41	24.3	24	14.2	65	19.2		
Maturity status	Premature	19	11.2	6	3.6	25	7.4	7.3	0.026*
	Full term	140	82.8	152	89.9	292	86.4		
	Post-term	10	5.9	11	6.5	21	6.2		
Gestational age	≤ 36 weeks	19	11.2	6	3.6	25	7.4	7.3	0.006*
	≥ 37 weeks	150	88.8	163	96.4	313	92.6		
	Mean	37.408		38.012		37.710		t=2.379	0.018*
	Median	38		38		38			
Birth weight	< 2500 g	34	20.1	7	4.1	41	12.1	20.235	0.000*
	≥ 2500 g	135	79.9	162	95.9	297	87.9		
	Mean	2838.76		3208.46		3023.61		t=5.928	0.000*
	Median	3000		3200		3000			
Experiencing complication during	Yes	35	20.7	39	23.1	74	21.9	0.277	0.693
	No	134	79.3	130	76.9	264	78.1		

Variable		Case (169)		Control (169)		Total (338)		Chi square	Sig.
		No	%	No	%	No	%		
delivery									
Admission to NICU	Yes	47	27.8	23	13.6	70	20.7	10.378	0.002*
	No	122	72.2	146	86.4	268	79.3		
Being mechanical ventilated	Yes	26	15.4	10	5.9	36	10.7	7.959	0.007*
	No	143	84.6	159	94.1	302	89.3		
Experiencing neonatal jaundice	Yes	60	35.5	66	39.1	126	37.3	0.456	0.287
	No	109	64.5	103	60.9	212	62.7		
Type of N. jaundice	Physiological	34	56.7	55	83.3	89	70.6	10.775	0.002*
	Pathological	26	43.3	11	16.7	37	29.4		
Congenital anomalies	Yes	16	9.5	6	3.6	22	6.5	4.862	0.045*
	No	153	90.5	163	96.4	316	93.5		
Experiencing serious illnesses	Yes	49	29	28	16.6	77	22.8	7.417	0.009*
	No	120	71	141	83.4	261	77.2		
Suffering from meningitis or encephalitis	Yes	18	10.7	11	6.5	29	8.6	1.848	0.244
	No	151	89.3	158	93.5	309	91.4		
Exposure to recurrent Otitis Media	Yes	20	11.8	3	1.8	23	6.8	NA#	0.000*
	No	149	88.2	166	98.2	315	93.2		
Child Exposure to trauma	Yes	22	13	23	13.6	45	13.3	0.026	1.000
	No	147	87	146	86.4	293	86.7		
Use of ototoxic medications	Yes	17	10.1	1	0.6	18	5.3	NA#	0.000*
	No	104	61.5	143	84.6	247	73.1		
	Don't know	48	28.4	25	14.8	73	21.6		
History of child hospital admission	Yes	72	42.6	50	29.6	122	36.1	6.208	0.017*
	No	97	57.4	119	70.4	216	63.9		
Child exposure to imaging	Yes	82	48.5	32	18.9	114	33.7	33.091	0.000*
	No	87	51.5	137	81.1	224	66.3		
Frequency of imaging	≤ 2	54	65.9	28	87.5	82	71.9	NA#	0.022*
	≥ 3	28	34.1	4	12.5	32	28.1		
Use of antibiotics	Yes	145	85.8	139	82.2	284	84	0.793	0.458
	No	24	14.2	30	17.8	54	16		
Frequency of antibiotics	≤ 5 times	100	69	112	80.6	212	74.6	5.055	0.029*
	≥ 6 times	45	31	27	19.4	72	25.4		
Child Exclusively breast fed	Yes	73	44.2	97	58.4	170	51.4	6.671	0.011*
	No	92	55.8	69	41.6	161	48.6		

*Significant relationship, # Fisher's Exact Test was used

Responses from mothers of cases and controls were different regarding mode of delivery. The percent of mothers of cases who delivered normally was 75.7% compared to 85.8% of controls. The percent of mothers of cases delivered by instrumental (Forceps or ventose) or caesarian section was 24.3% compared to 14.2% of controls (chi 5.505 p value 0.027, OR 0.517 CI 0.296-0.902). Women who delivered normally at a lower risk of having child with hearing impairment by 49%. This could be related to complication such as asphyxia or trauma during delivery. Quality of perinatal services could play a role. Large sample is needed to investigate this relationship.

As Table 7 shows, 11.2% of cases were premature (gestation age less than 37 weeks) compared to 3.6% of controls (chi 7.3 p value 0.006, OR 3.441 CI 1.338-8.847). Prematurity was associated with hearing impairment in many research studies (Bielecki et al, 2011, Gouri et al, 2015, WHO, 2016b, Seniuk et al, 2017).

Low birth weight shows significant difference between cases and controls. The percent of cases whose birth weight below 2500 gram is 20.1% compared to only 4.1% of controls (chi 20.235 p value 0.000, OR 5.829 CI 2.504-13.568), the risk of hearing impairment in low birth weight children is 5.8 times the risk in normal weight category. Low birth weight and severe low birth weight (<1500 grams) was identified as a risk factor for hearing impairment in many studies (Bielecki et al, 2011, WHO, 2013, Seniuk et al, 2017).

Table 7 shows that admission to NICU was higher among cases than controls as it was 27.8% among cases and 13.6% among controls (chi 10.378 p value 0.002, OR 2.445 CI 1.406-4.254), admission to NICU increased the risk of hearing impairment by 1.4. This result is congruent with research findings in other settings (Bielecki et al, 2011, Pourarian et al, 2012, Baradaranfar et al, 2014). The main cause of NICU admission was hypoxia (22.6%), followed by respiratory distress (19.8%), low birth weight (17%) and prematurity (14.2%)

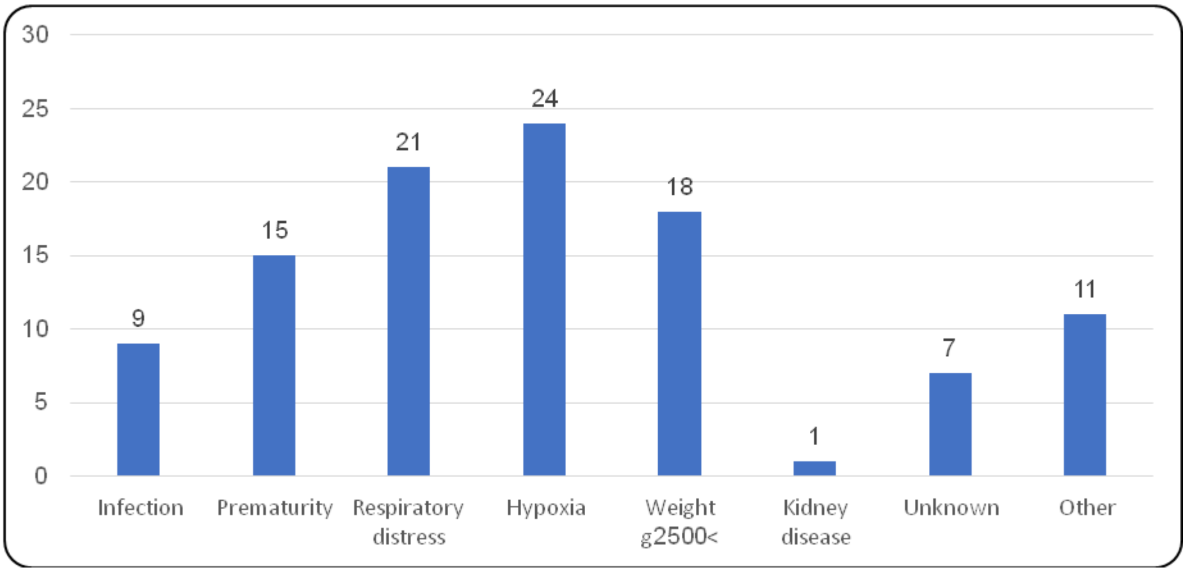

Figure 6: Causes of NICU admission

Another factor related to NICU admission, is the use of mechanical ventilation. The percent of cases who reported using mechanical ventilation was 15.4% compared to only 5.9% of controls (chi 7.959 p value 0.007, OR 2.891 CI 1.347-6.203). The mean duration of mechanical ventilation is 9 days while the median is 3 days. Mechanical ventilation is found to be associated with hearing impairment in many studies, which defer in the cut point of duration of mechanical ventilation (Bielecki et al, 2011, Gouri et al, 2015, Seniuk et al, 2017, Greczka et al, 2017). No cut point is determined in this research as the sample is small (36 cases and controls). All infants admitted to NICU or had mechanical ventilation should be screened for hearing impairment.

Table 7 depicts that history of neonatal jaundice shows no statistically significant differences between cases and controls. The percent of cases who developed jaundice was 35.5% compared to 39.1% of controls (p value 0.287). The mean duration of jaundice was 2.14 weeks and the median were 2 weeks. On the other hand, the significant differences were in causes and management of jaundice. The percent of cases who had physiological jaundice was 56.7% while 43.3% had pathological jaundice, on other hand, the percent of controls were 83.3% and 16.7% respectively (chi 10.775 p value 0.002, OR 0.262 CI 0.115-0.597). Regarding management of jaundice, jaundiced cases who had blood exchange constituted 13.3% compared to zero percent of controls. Even this couldn't be analyzed due to zero value in controls,this finding is supported by different literature and research, hyperbilirubinemia (jaundice) that is severe enough to require a blood transfusion can result in hearing loss (National Institute on Deafness and Other Communication Disorders, 2014). A cohort design used in California concluded that only bilirubin levels ≥ 35 mg/dL were associated with a statistically significant increased risk of SNHL (Wickremasinghe et al, 2015). Another retrospective, case-control study was done in Mexico disclosed a high frequency of SNHL in children with neonatal hyperbilirubinemia and exchange-transfusion (Cruz et al, 2014).

Responses from mothers of cases and controls show significant difference regarding suffering from congenital anomalies. The percent of cases who have congenital anomalies was 9.5% compared to 3.6% of controls (chi 4.862 p value 0.045, OR 2.814 CI 1.084-7.448). The main affected parts are skull and face followed by ear. A recent study revealed that children with craniofacial anomalies are 2.6 times more likely to develop a postnatal hearing loss than children without cranio-facial anomalies (Beswick & Driscoll, 2013).

Experiencing serious illness was significantly higher in cases more than controls. The percent of cases who suffered from serious illness was 29% compared to 16.6% of controls (chi 7.417 p value 0.009, OR 2.056 CI 1.217-3.473), children who suffered from serious illness during the first 3 years of life have a risk of hearing impairment two times the risk of children with no history. In specific it was found that meningitis or encephalitis didn't show significant differences between cases and controls. The percent of cases who suffered from meningitis is 10.7% compared to 6.5% of controls (p value 0.244). A study conducted in Kenya concluded that sensorineural hearing loss was found to be highly prevalent in children treated for bacterial meningitis (Karanja et al, 2014). This unclear result could be because of small sample or because of the introduction of pneumococcal and hemophillus influenza vaccines had lowered the incidence of new cases of meningitis. This result emphasizes the importance of adherence and full coverage of immunization as one way to decrease disability. More studies are needed specially that it was not possible to identify the type of meningitis if it is bacterial or viral.

Responses from cases and controls regarding recurrent otitis media shows significant relationship. Mothers of cases who reported the occurrence of recurrent otitis media constituted 11.8% of all cases while controls constituted only 1.8% (p value 0.000, OR 7.427 CI 2.163-25.499). An otitis media which occurs over and over again, can damage the eardrum, the bones of the ear, or even the hearing nerve and cause a permanent, sensorineural hearing loss (The American Speech-Language-Hearing Association, 2017). In severe and long-lasting cases, otitis media can lead to permanent hearing loss (Borgia, 2016).

Exposure of child to serious trauma shows the same responses between cases and controls. Cases and controls percent of positive response to trauma exposure was 13% and 13.6% respectively (p value 1). The total number of children whom exposed to trauma was 45 and it was not possible to address head trauma in specific.

As table 7 shows, the responses regarding use of ototoxic medications showed significant differences between cases and controls. The percent of mother of cases who admitted the use of ototoxic medications was 10.1% compared to only 0.6% of controls (p value 0.000). This could be explained by that more cases were admitted to NICU as showed above, on other hand controls may be exposed more to recall bias. It worthy to mention that 21.6% of all sample had no idea about exposure to ototoxic medications and this suggest information gap in families and poor medical counselling. Use of ototoxic medicines in pregnant women and children is responsible for 4% of childhood hearing loss, which could potentially be avoided (WHO, 2016b). A study conducted in Northern Thailand concluded that ototoxic exposure is a risk factor for bilateral hearing loss in infants (Poonual et al, 2015).

Mothers of cases responses showed that they were admitted to hospital more than controls. The percent of cases who were admitted to hospital for any reason was 42.6% compared to 29.6% of controls (Chi 6.208 p value 0.017, odd ratio 1.767 CI 1.127-2.769). As showed above cases were diagnosed with more congenital anomalies, more serious illness and infection which could explain this result. Admission to hospital increase the risk of ototoxic medications such as gentamycin. The usual time of onset of ototoxicity is often unpredictable and marked hearing loss can occur even after a single dose. Additionally, hearing loss may not manifest until several weeks or months after completion of antibiotic or antineoplastic therapy (Mudd, 2016).

Responses from cases and controls shows that cases were exposed to imaging more than controls. The percent of cases who admitted the exposure to imaging was 48.5% compared to 18.9% of their counterparts (chi 33.091 p value 0.000, OR 4.035 CI 2.475-6.580). This relationship properly reflects the burden of hearing impairment rather than risk factor. Even the frequency of imaging exposure was higher in cases, 34.1% of them reported exposure to imaging three times or more compared to 12.5% of controls (p value 0.022, CI 0.088-0.864). Cases families has long journey before reaching the diagnosis of hearing impairment.

As table 7 shows, cases and controls history of antibiotics use is approximate, 85.8% versus 82.2% (p value 0.458). On other hand, the responses showed that cases used antibiotics more frequently than controls. The percent of cases who used antibiotics for six times and more was 31. %, but it’s only 19.4% for controls (chi 5.055 p value 0.029, OR 0.536 CI 0.310-0927). Again, this could reflect burden of hearing impairment and its associated illness and complications rather than causation. The most used antibiotics were Amoxicillin, Ogmin, Keflex and Sulprim. Gentamycin was mentioned by 7 cases only.

Regarding exclusive breast feeding, the percent of cases who had exclusive breast feeding was 44.2% compared to 58.4% of controls (chi 6.671 p value 0.011, OR 0.564 CI 0.365-0.872), exclusive breast feeding decreased the risk of hearing impairment by 43.6%. A study done in Flanders and Belgium, showed a significant association between bottle feeding and the prevalence of congenital hearing impairment (p value 0.002, OR 1.747 CI

1.225–2.491) (Kerschaver et al, 2013). Exclusive breast feeding should be encouraged at all level and all barriers should be addressed.

4.8 Health service Provision

Responses from mothers of cases and controls shows that there were no statistically significant differences between cases and controls regarding receiving PCC. The percent of mothers of cases who had PCC before pregnancy was 55.6% compared to 52.7% of controls (p value 0.662). PCC is a relatively new service introduced firstly at UNRWA clinics in 2009, then it's now provided by other health care providers. This unclear result raises a query about the PCC provided and the activities done in this service. A deeper analysis regarding PCC aim and quality is needed because PCC can reduce maternal and child mortality, prevent complications during pregnancy and delivery, prevent stillbirths, preterm birth and low birth weight, prevent birth defects, and prevent neonatal infections (WHO, 2013b).

Interestingly the responses from mothers of cases and controls showed significant difference regarding receiving the ANC (OR 0.12 CI 0.015-0.969 p value 0.037) and even the timing of registration. The percent of mothers of cases who registered at first trimester was 76.4% compared to 90.5% of controls (chi 11.878 OR 0.341 CI 0.181-0.640 p value 0.002), for more details, see table 8.

Table 8: Distribution of participants (cases and controls) by health service provision (N=338)

Items	category	Case		Controls		Total		Chi	Sig.
		No	%	No	%	No	%		
Receiving PCC	Yes	94	55.6	89	52.7	183	54.1	0.298	0.662
	No	75	44.4	80	47.3	155	45.9		
Receiving ANC	Yes	161	95.3	168	99.4	392	97.3	NA#	0.037*
	No	8	4.7	1	0.6	9	2.9		
No of ANC visits	Mean	6.93		7.12		7.03		t= 0.627	0.531
	Median	8		7		8			
Early ANC registration (trimester)	1st	123	76.4	152	90.5	275	83.6	11.878	0.001*
	2nd or 3rd trimester	38	23.6	16	9.5	37	11.2		
Completeness of ANC visit									
BP measurement	Yes	150	93.2	166	98.9	316	96	NA#	0.031*
	No	4	2.5	1	0.6	5	1.5		
	Don't remember	7	4.3	1	0.6	8	2.4		
Breast exam	Yes	89	55.3	119	70.8	208	63.2	8.948	0.011*
	No	49	30.4	36	21.4	85	25.8		
	Don't remember	23	14.3	13	7.7	36	10.9		
Full medical examination	Yes	88	54.7	126	75	214	65	16.292	0.000*
	No	35	21.7	25	14.9	60	18.2		

Items	category	Case		Controls		Total		Chi	Sig.
		No	%	No	%	No	%		
of the mother	Don't remember	38	23.6	17	10.1	55	16.7		
Place of delivery	MOH hospital	143	84.6	134	79.3	277	82	1.750	0.417
	Private hospital	19	11.2	27	16	46	13.6		
	Private clinic	7	4.1	8	4.7	15	4.4		
Receiving PNC	Yes	95	56.2	77	45.6	172	50.9	3.836	0.064
	No	74	43.8	92	54.4	166	49.1		
Result of new born exam	No feed back	21	12.7	9	5.4	30	8.9	NA#	0.02*
	Normal	139	83.7	156	93.4	29.5	87.3		
	abnormal	6	3.6	2	1.2	8	2.4		
Facing barrier to health services	Yes	27	16	43	25.4	70	20.7	4.612	0.044*
	No	142	84	126	74.6	268	79.3		

*Significant relationship, # Fisher's Exact Test was used

There is no clear relationship between hearing impairment and antenatal care in the literature, but the relationship is well known between antenatal care and birth outcome mainly prematurity and low birth weight. Prematurity and low birth weight are well known risk factors of hearing impairment. In this research, the mean birth weight of newborns whose mothers had ANC was 3037.33gram compared to 2522.22 grams of who hadn't ANC (t test 2.56 p value 0.011, Annex 6 table 12). The mean GA of newborns whose mothers has ANC was 37.7 weeks compared to 36.56 weeks of who hadn't ANC (t test 1.498, p value 0.135, annex). A cross-sectional study conducted in Iraq concluded that early booking at a health center need to be properly advocated to mothers to avoid poor birth outcome such as low birth weight (Abdal Qader et al, 2012). A research was done in remote areas in Pakistan showed that mothers who received antenatal care were more likely to deliver normal weight babies compared to those who did not (OR 4.3 CI 2.6-7.3 p <0.001). The completeness of ANC was studied by different indicators, of which three shows significant differences between cases and controls.

Table 8 elucidates that the percent of cases mothers who had BP measurement was 93.2% compared to 98.9% of controls (p value 0.031). The percent of cases who had breast exam and full medical examination was 55.3% and 54.7% compared to 70.8% and 75% of controls respectively (p value 0.011 and 0.000). The completeness of ANC can give an indication of the quality of care provided to case and controls which could affect the birth outcome. A larger study is needed to study the effect of quality of care on congenital anomalies including hearing impairment.

The place of delivery showed approximate proportion among cases and controls. The percent of mothers of cases who delivered at MOH hospitals, private hospitals, and private clinics was 84.6%, 11.2% and 4.1 respectively. The percent of controls was 79.3%, 16% and 4.7% respectively. The place of delivered with its equipment and staff skills could affect the birth outcome, but this was not obvious in this research.

As table 8 explicit, there was mild difference between cases and controls mothers in receiving PNC but not reaching significant value. The percent of cases who received PNC was 56.2% compared to 45.6% of controls (p value 0.064). On the other hand, the significant difference was regarding receiving feedback about child examination by physician during first visit after birth.

Table 8 brings to light the difference between cases and controls regarding feedback from health care provider, the percent of mothers of cases who received a feedback as normal baby was 83.7% compared to 93.4% of controls, 12.7% of cases mothers had no feedback compared to 5.4% of controls, and 3.6% of cases mothers received feedbacks of abnormal baby compared to 1.2% of controls (p value 0.02). It's truly this is not a risk factor but in the previous part of this research, it was showed that cases had more congenital anomalies than controls. This finding is very important in the early suspicion and diagnosis and asserts the role of health care provider from the first newborn exam. It worth to mention that even not all mothers in this research received PNC, all newborns were examined and this define a gap in the service provided by all sectors which needs more enhancement and supervision.

Surprisingly, mothers of cases reported less barriers to health care services. The percent of mothers of cases who reported facing health barriers was 16% compared to their counterpart who reported 25.4% (chi 4.612 p value 0.044). This could be explained by that families who have children with any form of disability are included in the medical insurance and supported by social services as seen in previous section. There are also special organizations for children with hearing impairment. The main cause of health services barrier was economic (77.2%) followed by lack of expertise (12.7%).

4.9 Environmental conditions and exposure

Exposure to loud noise during infancy or childhood, shows significant difference between cases and controls. The percent of cases who had been exposed to continuous loud noise is 34.3% compared to 17.8% of controls (Chi 12.045 p value 0.01, OR 2.421 CI 1.459-4.018). Exposure to loud sounds for prolonged periods can lead to hearing loss, even short, high intensity sounds, such as fireworks and shooting, may cause permanent hearing loss (WHO, 2016b). Harmful noises at home might come from sources such as leaf blowers, lawn mowers and the use of power tools (Weiss, 2016). In a Scandinavian research hearing tests in 538 teenage boys revealed a hearing loss in 15% and that the characteristics of the loss is indicated that the majority were related to noise exposure (Harrison, 2012). Although the study population is young, loud noise could increase the progression of hearing impairment rather than causing the hearing impairment alone. This area needs more investigation to analyze the interaction between different variables and to determine the level of dangerous loud noise

Table 9:Distribution of participants (cases and controls) by environmental conditions (N=338)

Independent variable	category	Cases		Controls		Total		Chi	Sig.
		NO	%	NO	%	NO	%		
Exposure to loud noise continuously	Yes	58	34.3	30	17.8	88	26	12.045	0.01*
	No	111	65.7	139	82.2	250	74		
Exposure to very high noise even one time	Yes	78	45.2	53	31.4	131	38.8	7.790	0.007*
	No	91	53.8	116	68.6	207	61.2		
Exposure of child to smoking	Yes	67	39.6	61	36.1	128	37.9	0.453	0.575
	No	102	60.4	108	63.9	210	62.1		
Presence of a factory near the house	Yes	21	12.4	21	12.4	42	12.4	0	1.000
	No	148	87.6	148	87.6	296	87.6		
Exposure to chemicals	Yes	18	10.7	11	6.5	29	8.6	1.848	0.244
	No	151	89.3	158	93.5	309	91.4		
House is well-ventilated	Yes	135	79.9	147	87	282	83.4	3.082	0.107
	No	34	20.1	22	13	56	16.6		
House is exposed to sun ray	Yes	122	72.2	135	79.9	257	76	2.744	0.126
	No	47	27.8	34	20.1	81	24		
House contains Asbestos	Yes	40	23.7	36	21.3	76	22.5	0.272	0.696
	No	129	76.3	133	78.7	262	77.5		
Presence of a pumping site near the dwelling	Yes	27	16	22	13	49	14.5	0.597	0.537
	No	142	84	147	87	289	85.5		
Presence of Trash container near the dwelling	Yes	46	27.2	17	10.1	63	18.6	16.407	0.000*
	No	123	72.8	152	89.9	275	81.4		
Dwelling is located near a petrol station	Yes	26	15.4	20	11.8	46	13.6	0.906	0.428
	No	143	84.6	149	88.2	292	86.4		

*significant relationship

The source of continuous loud noise was mainly road traffic noise (32%), followed by music (22%) and generators (20%). Even exposure to very loud noise shows significant difference. The percent of cases who were exposed to very loud noise was 45.2% compared to 31.4% of their counterparts (chi 7.790 p value 0.007, OR 1.876 CI 1.203-2.924). The main causes of very loud noise were being near explosion (78%), followed by sonic bombing (17%) as shown figure 7.

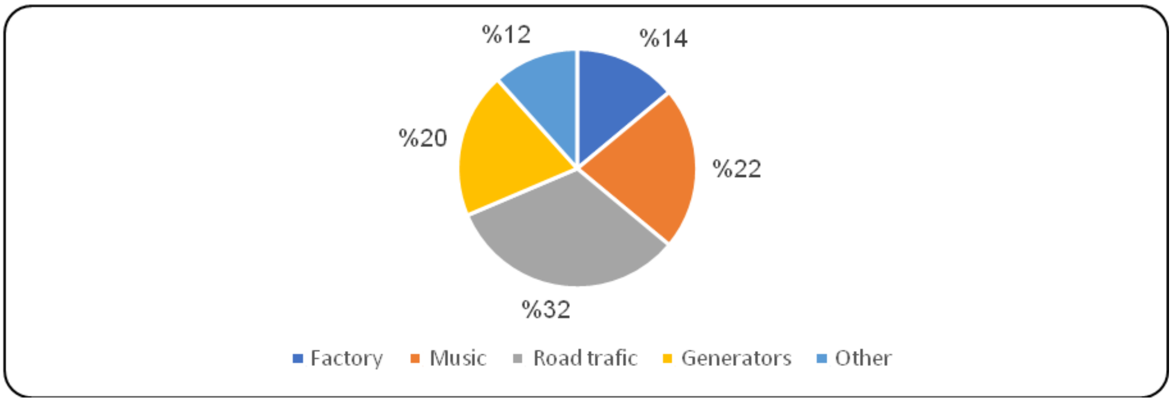

Figure 7: Sources of continuous loud noise

As table 9 shows, the percent of cases who were exposed to smoking was 39.6% compared to 36.1% of the controls, yet the difference is not reaching significant level (p value 0.575). This finding is contradictory to the literature. A study was done in Egypt, showed that passive smoking in childhood correlates with sensorineural hearing loss (Sanyelbhaa et al, 2014). A study conducted in Brazil to analyze the effect of tobacco smoke exposure during childhood on cochlear physiology suggested that nicotine can the damage the cochlear structures and indicated a possible loss in hearing and hearing ability development (Durante et al, 2013). More analysis is needed and larger sample could help in this area. The high prevalence of smoking could affect the results.

Cases and controls reported the same percent of living nearby a factory. Cases who lived near factory constituted 12.4% of all cases, controls have the same percent. Types of factories didn't show significant difference as a limited number of factories exist in Gaza, most of them are food product and clothes.

As table 9 shows, responses from cases and controls showed that 10.7% and 6.5% respectively were exposed to chemical in their daily life, but the difference are not statistically significant (p value 0.244). The most common sources of chemicals were pesticides, insecticides followed by home detergents. Chemical exposures and their effects need more detailed research. The type, duration and concentration of chemicals could affect any result which is not the scope of this research.

Dwellings conditions were better in terms of ventilation and sun rays' exposure in controls than cases but the differences didn't reach statistical significant level. The percent of cases who admitted that their houses are well ventilated with adequate sun rays was 79.9% and 72.2% respectively. Their counterparts' percent was 87% and 79.9% respectively (p value 0.107, 0.126). Home conditions could affect the recurrence of otitis media. Home conditions can give a clue to the socioeconomic status of families which was discussed in previous section. The same finding is applied to the presence of asbestoses in dwelling, the responses from cases and controls shoes that 23.7% of cases had asbestos in their dwellings compared to 21.3% of controls, but the difference is not significant (p value 0.696).

As table 9 shows that more cases' dwellings were located near pumping sites distributed as 16% of cases compared to 13% of controls. However, the differences are not statistically significant (p value 0.537), it seems that larger sample is needed to establish a relationship if exist.

The percent of cases whose dwellings were located near trash container was 27.2% compared to only 10.2% of controls, nevertheless, the differences among the two groups were statistically significant (chi 16.407 p value 0.000, OR 3.344 CI 1.826-6.123). This interesting finding needs more analysis and investigation. One explanation that garbage in Gaza is not separated with a combination of hazardous and non-hazardous waste. A case control study aimed to evaluate the association of lead and cadmium exposure with pediatric hearing ability. The study suggested that early childhood exposure to lead may be an important risk factor for hearing loss, and the developmental auditory system might be affected in e-waste polluted areas (Liu et al, 2018). Another explanation that garbage in any area or dumping ground is a good breeding ground for flies, cockroaches, insects and mosquitoes. Garbage not only causes land pollution but also air pollution by emission of harmful gases, when it is burnt which remains in breathing zone of animals and human beings (Sarkar, 2016), yet the relation with hearing impairment is not direct.

As table 9 shows, the percent of cases who lived near petrol station was 15.4% compared to 11.8% of controls, but the differences between the two groups were not statistically significant level (p value 0.428). It was reported that long term exposure to fuel, toxic gases may adversely affect human health. For example, smoke affects the respiratory organs and the skin, lead affects the respiratory, the nervous and the cardiovascular system, the nitric oxides cause asthma, allergies and malignant diseases. Hard particles from the combustion are also cancerous (Dimiskovka, 2012). Effect on hearing needs more research.

From above data, the researcher observed that the most significant environmental factor is noise pollution, which is well documented to be associated with hearing impairment.

To sum up, Table 10, depicts a summary of the significant variables that potentially constitute the risk factors for hearing impairment in Gaza.

Table 10: Summary of statistical significant variables

Variables	Exposure among cases		Exposure among controls		Bivariate analysis		
	No	%	No	%	OR	95% CI	P value
Being refugee	112	66.3	92	54.4	1.645	1.059-2.553	0.027
Residing in rural areas or camps	75	44.4	14	8.3	8.834	4.726-16.512	0.000
Mother unemployment	166	98.8	158	93.5	3.877	1.062-14.15	0.025
Receiving social assistance	96	56.8	60	36.1	2.323	1.497-3.605	0.001
Consanguinity marriage	120	71	66	39.1	3.822	2.428-6.017	0.001
Positive family history of hearing impairment	60	35.5	10	5.9	8.752	4.293-17.846	0.001
History of PIH during pregnancy	37	21.9	18	10.7	2.351	1.278-4.327	0.004
History of high grade fever during pregnancy	19	11.2	4	2.4	5.225	1.738-15.707	0.001
Medication use during pregnancy	105	62.1	71	42	2.265	1.465-3.501	0.000
Aspirin use during pregnancy	23	13.6	11	6.5	2.263	1.066-4.804	0.023
Maternal exposure to imaging during pregnancy	25	14.8	7	4.1	4.018	1.687-9.568	0.001
Maternal exposure to trauma during pregnancy	26	15.4	10	5.9	2.891	1.347-6.203	0.004
Preconception Folic acid duration < 3 months	63	63.6	35	43.2	2.30	1.261-4.194	0.007
Use of Folic acid in first trimester	113	85	136	97.1	0.166	0.055-0.500	0.000
Intake of Iron supplement during pregnancy	108	63.9	135	79.9	0.446	0.273-0.728	0.002
Normal spontaneous vaginal delivery	128	75.7	145	85.8	0.517	0.296-0.902	0.027
Gestational age less than 36 weeks	19	11.2	6	3.6	3.441	1.338-8.847	0.006
Birth weight less than 2500 grams	34	20.1	7	4.1	5.829	2.504-13.568	0.000
Admission to NICU	47	27.8	23	13.6	2.445	1.406-4.254	0.002

Variables	Exposure among cases		Exposure among controls		Bivariate analysis		
	No	%	No	%	OR	95% CI	P value
Mechanical ventilation of new born	26	15.4	10	5.9	2.891	1.347-6.203	0.007
Physiological rather than pathological jaundice	34	56.7	55	83.3	0.262	0.115-0.597	0.002
Congenital anomalies of new born	16	9.5	6	3.6	2.814	1.084-7.448	0.045
Experiencing serious illness of child	49	29	28	16.6	2.056	1.217-3.473	0.009
Recurrent otitis media	20	11.8	3	1.8	7.427	2.163-25.499	0.000
Use of ototoxic medication for the child	17	10.1	1	0.6	NA		0.000
Exclusive breast feeding for six months	73	44.2	97	58.4	0.564	0.365-0.872	0.011
Receiving ANC	161	95.3	168	99.4	0.12	0.015-0.969	0.037
Early registration in first trimester	123	76.4	152	90.5	0.341	0.181-0.640	0.001
Exposure of child to continuous loud noise	58	34.3	30	17.8	2.421	1.459-4.018	0.01
Exposure of child to very high noise even once	78	45.2	53	31.4	1.876	1.203-2.924	0.007
Presence of trash container near dwelling	46	27.2	17	10.1	3.344	1.826-6.123	0.000

4.10 Relationships amongvariables.

The identifiedrisk factors emerged in this research are possibly interact and affect each other, therefore a logistic regression model was run for the group of variables which showed statistical significanceand constituting the domainsaccording to the assumption illustrated in the conceptual framework. The following tables describe the result of regression model and unfold the most important risk factors in this research for each group of variables.

4.10.1 Relationships among socioeconomic variables.

Table 11: Logistic regression analysis for statistically significant sociodemographic variables

Variable	B	S.E.	Wald	df	Sig.	Exp(B)	95% CI.f or Exp (B)	
							Lower	Upper
Being refugee	0.047	0.259	0.033	1	0.855	1.048	0.631	1.742
Mother's unemployment	1.827	.746	6.002	1	0.014*	6.216	1.441	26.814
Receiving social assistance	0.540	.254	4.524	1	0.033*	1.715	1.043	2.820
Residing in rural areas or camps	2.185	.346	39.781	1	0.000*	8.890	4.508	17.529
Constant	-6.689	1.144	34.164	1	0.000	0.001		

*Statistically significant

From Table 11, the most important risky groups are children whose mothers are unemployed and children from families receiving social assistance. This flags the important contribution of poverty and socioeconomic conditions to hearing impairment. Unemployment of mothers increased the risk of hearing impairment in children by more than 6 folds. Employed mothers have better economic and social choices and have better resources which affect their living conditions, life choices and also better access to livelihoods and services. Also, children residing in rural areas or camps were at greater risk, again this should be taken with cautious as this result could be biased due to the absence of universal screening and unequal coverage all over GazaGovernorates.

4.10.2 Relationship among family historyrelated variables.

Table 12: Logistic regression analysis for statistically significant familial variables

Variable	B	S.E.	Wald	Df	Sig.	Exp(B)	95% CI for EXP(B)	
							Lower	Upper
Interfamily marriage	1.169	0.245	22.859	1	0.000*	3.219	1.993	5.198
Positive family history	1.991	0.372	28.609	1	0.000*	7.324	3.531	15.192
Constant	-5.330	0.078	46.178	1	0.000	0.005		

*Statistically significant

As table 12 shows, family history and consanguinity are strong risk factor of hearing impairment. Children belonging to families with positive history have 7-folds and more increase in the risk of hearing impairment, those whose parents are relative have more than 3 times the risk of hearing impairment compared to their counterparts.These findings are supported by many other studies conducted in different countries, consanguinity, especially first degree relative marriages increase the prevalence of genetic congenital anomalies and nearly doubles the risk for neonatal and childhood death, intellectual disability and other anomalies (WHO, 2016a). Consanguinity marriage with its risk should be addressed as a top priority to combat its occurrence. Families with positive family history should be fully aware and properly counselled about the risk of having another child with hearing impairment. Those families should be targeted by screening programs as a priority.

4.10.3 Relationship among maternal variables.

Table 13: Regression analysis for statistically significant maternal variables

Variable	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for Exp(B)	
							Lower	Upper
History of PIH during pregnancy	0.128	0.456	0.078	1	0.780	1.136	0.465	2.777
History of high grade fever during pregnancy	1.411	0.909	2.410	1	0.121	4.101	0.690	24.356
Medication use during pregnancy	0.037	0.397	0.009	1	0.925	1.038	0.477	2.260
Aspirin use during pregnancy	0.244	0.594	0.169	1	0.681	1.277	0.399	4.086
Maternal exposure to imaging during pregnancy	0.504	0.672	0.562	1	0.453	1.656	0.443	6.184
Maternal exposure to trauma during pregnancy	0.977	0.742	1.734	1	0.188	2.657	0.620	11.379
Duration of preconception Folic acid in take	0.195	0.104	3.495	1	0.062	1.215	0.991	1.490
Use of Folic acid in first trimester	-1.824	0.825	4.891	1	0.027*	0.161	0.032	0.813
Intake of Iron supplement during pregnancy	-0.868	0.421	4.256	1	0.039*	0.420	0.184	0.958
Constant	-3.853	2.540	2.301	1	0.129	0.021		

*Statistically significant

As it’s obvious in table 13, when combined together, the most significant maternal factors which would affect the risk of hearing impairment are having folic acid early in pregnancy which decreased the risk by 83.9%andtaking iron supplementation during pregnancy which decrease the risk by 58%. These findings are supported by the literature(Taha et al, 2014), and explicitone way of protection against or at least decreasing the incidence of hearing impairment.

4.10.4 Relationship among fetal related variables.

Table 14: Regression analysis for statistically significant fetal related variables

Variable	B	S.E.	Wald	Df	Sig.	Exp(B)	95% CI for EXP(B)	
							Lower	Upper
Gestational age ≤ 36 weeks	0.119	0.591	0 .040	1	0.841	1.126	0.353	3.589
LBW	1.370	0.479	8.172	1	0.004*	3.935	1.538	10.065
AdmissionNICU	-0.006	0.445	0.000	1	0.989	0.994	0.416	2.377
Mechanicalventilation	0.486	0.561	0.751	1	0.386	1.626	0.541	4.887
Congenitalabnormality	0.466	0.561	0.692	1	0.406	1.594	0.531	4.786
Recurrent otitis media	1.801	0.647	7.762	1	0.005*	6.057	1.706	21.510
Exclusive breast feeding	-0.327	0.239	1.869	1	0.172	0.721	0.451	1.152
Constant	-7.668	2.092	13.436	1	0.000	0.000		

*Statistically significant

The most significant fetal factors showed in table 14are LBWand recurrent otitis media. LBW is identified in many studies as risk factors of hearing impairment (Bielecki et al, 2011, WHO, 2013, Seniuk et al, 2017). In this research LBW increased the risk of hearing impairment by almost 4 folds. Children with history of recurrent otitis media had 6 times the risk compared to children without that history, and this is supported by literature. These two categories of children should be under focus and targeted by screening and follow up program. Other factors such as admission to NICU and mechanical ventilation were not significant in this model. This finding contradicts the literature, probably due to small sample size rather than true insignificance role of this variable(Bielecki et al, 2011, Pourarian et al, 2012, Baradaranfaret al, 2014). Larger sample is needed to determine the contributions of these factors to hearing impairment.

4.10.5 Relationship among health services provision related variables.

Table 15:Regression analysis for the statistically significant health services related variables

Variable	B	S.E.	Wald	Df	Sig.	Exp(B)	95% C.I. for EXP(B)	
							Lower	Upper
Early registration	-0.968	0.329	8.647	1	0.003*	0.380	0.199	0.724
Medical exam (Yes) reference			13.082	2	0.001			
Medical exam (No)	-0.665	0.301	4.897	1	0.027*	0.514	0.285	0.927
Medical exam (don't remember)	-1.068	0.329	10.548	1	0.001*	0.344	0.180	0.655
Constant	1.457	0.398	13.395	1	0.000	4.292		

*Statistically significant

It's obvious that early registration in pregnancy and doing the needed medical examinationsrelated to pregnant decreases the risk of hearing impairment.Early registration in the first trimester decreases the risk of hearing impairment by 62%. Health care providers should enhance and encourage each pregnant woman to early register in order to detect any deviation from normal path of pregnancy. This allows early intervention and proper management of any complications which could affect the risk of hearing impairment.

4.10.6 Relationship among environmental related variables

Table 16: Regression analysis for significant environmental variables

Variable	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I for EXP(B)	
							Lower	Upper
Loud noise exposure	0.648	0.274	5.596	1	0.018*	1.912	1.118	3.272
Very high noise	0.371	0.242	2.347	1	0.125	1.449	.902	2.328
Nearby trash container	1.034	0.316	10.698	1	0.001*	2.814	1.514	5.230
Constant	-3.619	0.750	23.279	1	0.000	0.027		

*Statistically significant

Among the studied environmental factors, it's clear that exposure to loud noise and nearby trash container increased the risk of hearing impairment. Children exposed to loud noise at almost two times the risk of hearing impairment compared to those who are not exposed. Residing near trash container increased the risk of hearing impairment by 2.8 folds. Noise pollution is well known risk factor of hearing impairment in all age groups (WHO, 2016b). Nearby trash containers could reflect the bad living conditions and exposure to pollution and health risks thus it increases vulnerability of those families.

4.10.7 General model of logistic regression for all domains

Table 17: A model of logistic regression of all significant variables

Variable	**B**	**S.E.**	**Wald**	**df**	**Sig.**	**Exp(B)**	**95% CI for Exp(B)**	
							Lower	**Upper**
Receiving social assistance	0.651	0.305	4.573	1	0.032	1.918	1.056	3.484
Positive family history	1.316	0.309	18.181	1	0.000	3.730	2.037	6.831
Interfamily marriage	1.399	0.423	10.910	1	0.001	4.049	1.766	9.285
Use of Folic acid in first trimester	-1.961	0.712	7.593	1	0.006	0.141	0.035	0.568
Intake of Iron supplement during pregnancy	-0.759	0.363	4.361	1	0.037	0.468	0.230	0.954
LBW	1.326	0.529	6.277	1	0.012	3.765	1.335	10.621
Recurrent otitis media	1.534	0.742	4.278	1	0.039	4.638	1.084	19.848
Nearby trash container	1.210	0.445	7.402	1	0.007	3.353	1.403	8.016
Constant	-10.071	2.248	20.070	1	0.000	0.000		

Besides studying the interaction of significant factors within each domain, the researcher explored the interaction of all significant variables in this study. The model illustrated in table 17 shows that the most important variables that affects the risk of hearing impairment in this research. The model can explain more than 42% of differences between cases and controls. Families with consanguinity marriage, positive family history of hearing impairment and who receive social assistance at increased risk, all these findings are supported by the literature(Girotto et al, 2014).Pregnant woman who had folic acid early and who had iron supplement during her pregnancy had a lower risk of having a child with hearing impairment. History of LBW and recurrent otitis media increased the risk of hearing impairment. Residing near trash container increased the risk of hearing impairment reflecting the relationship with socioeconomic conditions.

Table 18: Model Summary

Step	-2 Log likelihoods	Cox & Snell R Square	Nagelkerke R Square
1	271.566	0.316	0.422

Conclusion and Recommendations

5.1 Conclusion

Hearing impairment has devastating consequences for interpersonal communication, psychosocial well-being, quality of life and economic independence. At the societal level, it also constitutes a huge financial and economic burden. The etiology of congenital or early-onset hearing loss most likely varies from a country to country. No previous studies were done to identify the risk factors of hearing impairment in Gaza governorates. The aim of this study was to explore the possible risk factors of hearing impairment in infant and children below three years in order to identify risky groups for prevention, decreasing or early detection of hearing impairment.

The frame work of this research included six domains, sociodemographic variables,family history, maternal& fetal diseases and exposures, environmental factors and health services provision.

The relationship between sociodemographic variables and hearing impairment in infants and toddlers was prominent. Most of rural areas are borderline and affected more by bombing and invasion which necessitate to focus more on those areas in any screening program. The researcher also concluded that refugees were at a greater risk, which could be an indicative of better utilization of screening program rather than a true risk.The relationships with family size or family type were not clear. The researcher didn’t find an association between hearing impairment in children and early marriage, young mothers or mother’s age. The level of education of mothers and fathers showed no significant relationship with hearing impairment

The economic situation was assessed through asking participant about their income and expenditure. The relationship was not clear and perhaps reflecting the tendency of underestimating their values. Interestingly receiving social assistance was more prominent in families having children with hearing impairment. Mother employment showed negative association with hearing impairment in their children, indicating the possible role of mother awareness of healthy practice in preventing hearing impairment. Father employment status or type of his work was not found to have an association with hearing impairment in this research, which rebutted the literature and this could be explained by high percent of unemployment and limited vacancies and opportunities.

The effect of housing conditions was not clear in this research. The researcher failed to found a clear association between hearing impairment and the kind of dwelling, number of bedrooms, type of occupancy and source of water either for drinking or domestic use.

Consanguinity practiced in Gaza was found to be strongly associated with hearing impairment in infants and toddlers. Also, family history of hearing impairment showed significant relationship. One finding of this research that affected families had poor knowledge and counselling regarding the type and risk of hearing impairment's inheritance. These results highlight the importance of pre-marriage counselling and the deep need of community to awareness and education.A national plan should be prepared to compact inherited hearing loss through pre-marriage counselling and screening, the plan should focus on this risky group in any screening program.

Results showed that medical and maternal history is associated with hearing impairment in many aspects. The researcher couldn't find a clear association between chronic diseases of mothers like hypertension and diabetes and hearing impairment, properly due to small sample size, on other hand, complications during pregnancy showed a positive relationship, namely pregnancy induced hypertension and high-grade fever. Mothers who used medications during pregnancywere found to be at a higher risk to have children with hearing impairment. Interestingly Aspirin in specific showed a positive relationship with hearing impairment. Maternal exposure to trauma or imaging were found to be associated with hearing impairment, but no association was found with nearby explosion or bombing. These previous results direct the health care provider to focus on maternal history during pregnancy for identification of risky groups; medications use and imaging should be strictly supervised. Hair dying or coloring was found not to have an effect on hearing impairment in this research. Another part of maternal history focused on supplements before and during pregnancy. Having folic acid in preconception period for three months and more was found to be negatively associated with hearing impairment, the same is applied for early use of folic acid during pregnancy. The same finding was concluded regarding having iron supplement during pregnancy. Mothers who have iron tablets during pregnancy were at a lower risk of having children with hearing impairment. The role of folic acid and iron supplement in improving pregnancy outcome is supported widely and adopted by WHO. The effect of preconception folic acid and iron supplement during pregnancy suggest a strong recommendation as one way of prevention or decreasing hearing impairment, which should be fostered by policy maker and health providers.

One of the most important results in this research is the effect of fetal, neonatal and childhood illness on the risk of hearing impairment. The birth interval was shorter for children with hearing impairment, even not reaching significant level; this should be helped in supporting the use of family planning methods to optimize the next pregnancy outcome. Instrumental and C.S delivery were associated with hearing impairment in this research. The researcher found that prematurity and low birth weight is strongly associated with hearing impairment in infants and toddlers. Consequences of prematurity such as admission to NICU and mechanical ventilation are also positively affect the development of hearing impairment. These findings are well documented in many literatures so these risky groups should be targeted by screening program if universal screening is not available. These results also illuminate one way of reducing hearing impairment which is controlling any maternal factor that could cause prematurity. Type of jaundice, pathological rather than just history of neonatal jaundice was found to be associated with hearing impairment, also severe jaundice that required blood exchanges of the infant increase the risk of hearing impairment in infants and toddlers. Children born with congenital anomalies mainly of head and face were at greater risk of hearing impairment. The researcher found that if the child had a history of recurrent otitis media, he or she would be at a greater risk of hearing impairment.The use of ototoxic medications also showed a positive relationship with hearing impairment. The relationship between exclusive breast feeding and hearing impairment was significant, children who had exclusive breast feeding for the first six months were at a lower risk of hearing impairment. Generally speaking the neonatal period is very critical and insults or diseases can affect the risk of hearing impairment. Children with hearing impairment were found to have recurrent usage of antibiotics and frequent imagining which reflects some of the burden of hearing impairment.

The researcher studied the available health services, utilization and their effect on the risk of hearing impairment. The researcher found that the most important association was with antenatal care. Not only having antenatal care, but early registration during the first trimester was strongly associated with hearing impairment. Women who registered at first trimester were at a lower risk of having children with hearing impairment. Interestingly the completeness of antennal care in terms of conducted activities also showed the same association.This result supports the role and importance of antenatal care in improving the birth outcome, each woman should be encouraged to register in the first trimester. The relationship between hearing impairment and preconception care, postnatal care and place of delivery was not clear. Most of mothers of children with hearing impairment either didn’t receive a feedback or negative feedback about their new born at first examination; this could be one of the target groups of early screening activity of hearing impairment. Physician suspicions after complete examination of new born should be enhanced to improve the early detection of hearing impairment.

Environmental factors and conditions were studied and the researcher found that some exposure can increase the risk of hearing impairment. Children exposed to continuous loud noise such as generators, traffic and music noise were at a higher risk of hearing impairment, and even children who were exposed to very high noise for one time were also at increased risk. Very high noise main source was bombing and explosion. Environmental exposure to chemicals was not found to have an association with hearing impairment. The same is applied for smoking, as the researcher failed to found an association between children’s exposure to smoking and hearing impairment. The environmental conditions of house like ventilation, enough sun rays and asbestos were not recognized as risk factors in this research. The relationship between nearby trash container and hearing impairment was prominent. Children whose houses were nearby trash container were at a greater risk of hearing impairment, on other hand the same relationship couldn’t be found with nearby pumping site or petrol station. The results of environmental factors study concluded that the most important factor is noise pollution which could be controlled and modified in order to decrease the risk of hearing impairment in infants and toddlers.

The researcher that families were not fully aware about the exact age of diagnosis of hearing impairment in their children. Records showed that most of children diagnosed after their first birthday, which is late. This late diagnosis should be enhanced to improve the potential and future of those children.

5.2 Recommendations

5.2.1 General recommendations

- Hearing impairment in children has huge impacts on the life of children and their families, therefore policy makers need to exert more effortsin designing programs for prevention, early detection and early intervention. In particular, universal screening is essential and plays a major role in cases identification and early intervention
- In the absence of universal screening, targeting risky groups becomes crucial. Screening program needs to be implemented as soon as possible to target children at the first weeks of life. Children who constitute priority for the proposed screening program are:
    - Premature or low birth weight infants
    - Infants admitted to NICU, need mechanical ventilation or blood exchange
    - Infants with positive family history or children belonged to families with consanguineous marriage
    - Children who suffer from recurrent otitis media
    - Infants and children from very poor families
- Health care providers need to collaboratively work tocontrol hearing impairment or at least decrease its occurrence, and this needs a strategic visioning to address the gaps in health care providers' knowledge and practices followed by appropriate training, identifying risky group and setting appropriate follow up strategies.
- Families with history of hearing impairment need counselling services and support including providing information about the possibility of its recurrence.
- Consanguinity marriage is a risk factor that should be addressed. Designing a program to address this phenomenon is essential with the involvement of influential people, like muktars, religious people and the media.
- Introduce and or reinforce pre-conception care which includes counseling and provision of appropriate supplementation (folic acid for at least three months and have iron supplements during pregnancy).
- More efforts are needed to improve the quality of ANC especially early registering during the first trimester to support pregnancy and detect any deviations.

- During pregnancy, maternal use of medications and exposure to imaging should be very restricted and under direct supervision of qualified health care provider.
- Measures to reduce prematurity and low birth weight need to be urgently taken as prematurity are associated with hearing loss.
- Safety measures are needed during and after pregnancy to protect fetus and children from injury and loud noise.
- Promote safe delivery practices to reduce or prevent complications including birth asphyxia.
- Communicable diseases like otitis media are risk factors that requires control and appropriate follow up of children experiencing these infections.

5.2.2 Recommendations for new areas of research

- A national survey should be conducted to estimate the prevalence of hearing impairment in children.
- More and larger research is needed to study the risk factors of hearing impairment.
- A research is needed to define the level of noise that could cause hearing impairment in children.
- A research is needed to study the effect of bombing and explosion on hearing ability in children in Gaza Governorates.
- A research is needed to determine the type of inheritance of congenital hearing impairment in Gaza Governorates.

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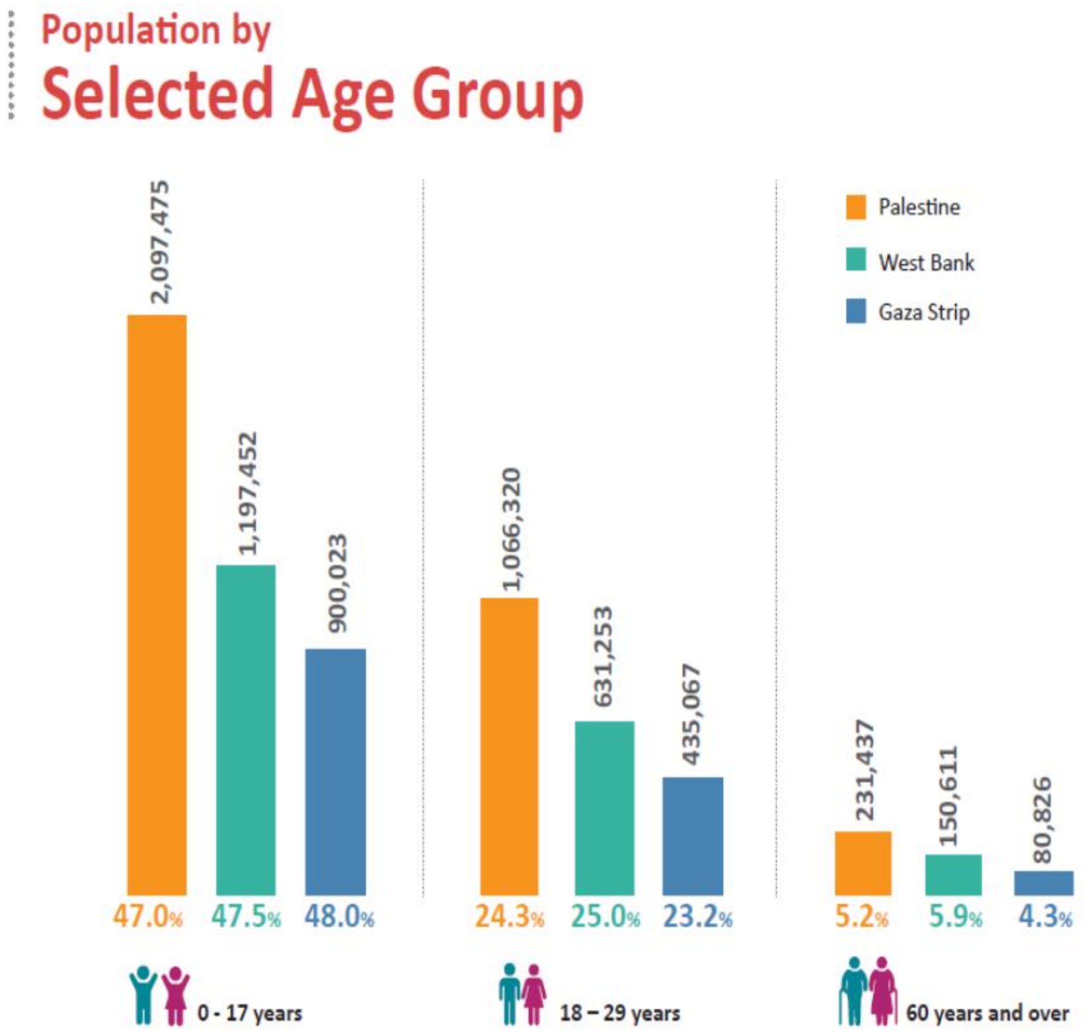
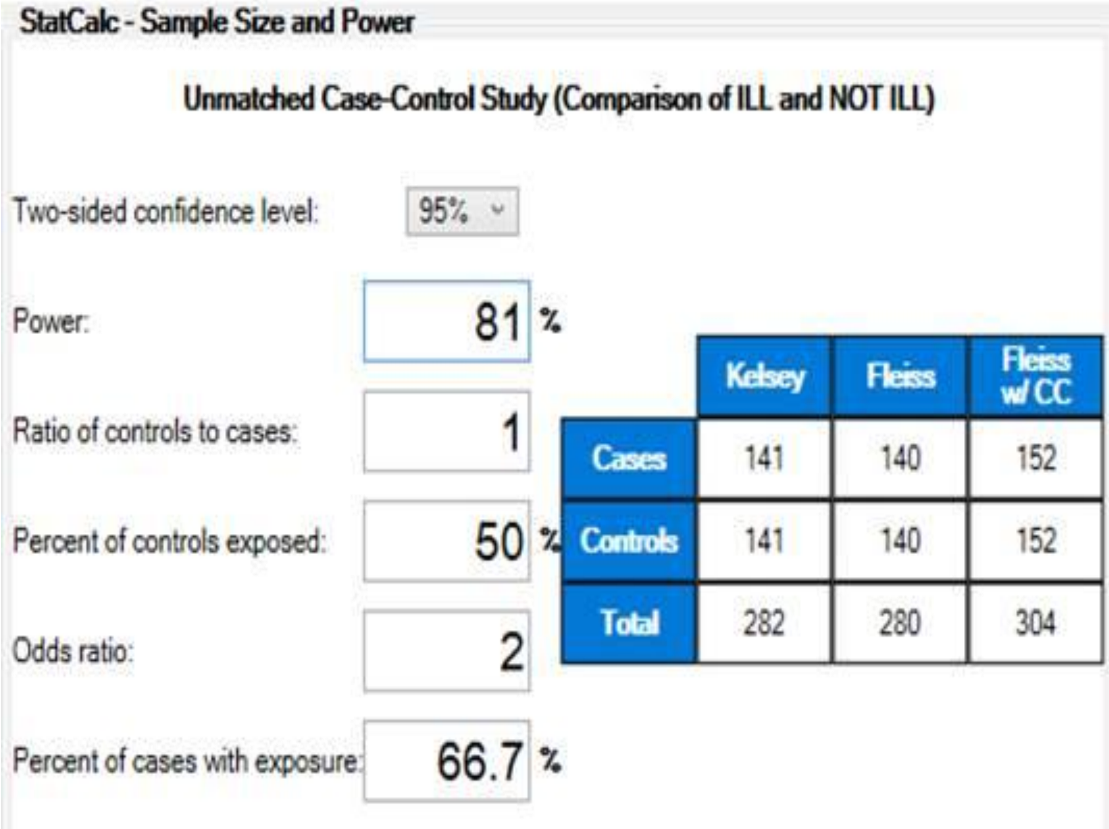
Annexes

Annex 1: Population by selected age group



Source: Preliminary Results of the Population, Housing and Establishments Census, 2017

Annex 2:Calculation of sample



Annex 3: Grades of hearing impairment according to WHO

Grade ofimpairment	HL inbetter ear	Qualitative description	Recommendations
0 No impairment	25 dB or better	No or very slight hearing	
1 Slight impairment	26 - 40 dB	Able to hear and repeat words spoken in normal voice at 1 meter	Counselling. Hearing aids may beneeded.
2 Moderate impairment	41 - 60 dB	Able to hear and repeatwords using raised voiceat 1 meter	Hearing aids usuallyrecommended
3 Severe impairment	61 - 80 dB	Able to hear somewords when shoutedinto better ear	Hearing aids needed. If notavailable, lip-reading andsigning should be taught.
4 Profound Impairmentincluding deafness	81 dB or greater	Unable to hear andunderstand even ashouted voice	Hearing aids may helpunderstanding words.Additionalrehabilitationneeded. Lip-reading andsometimes signingessential.

Annex 4:Other research findings

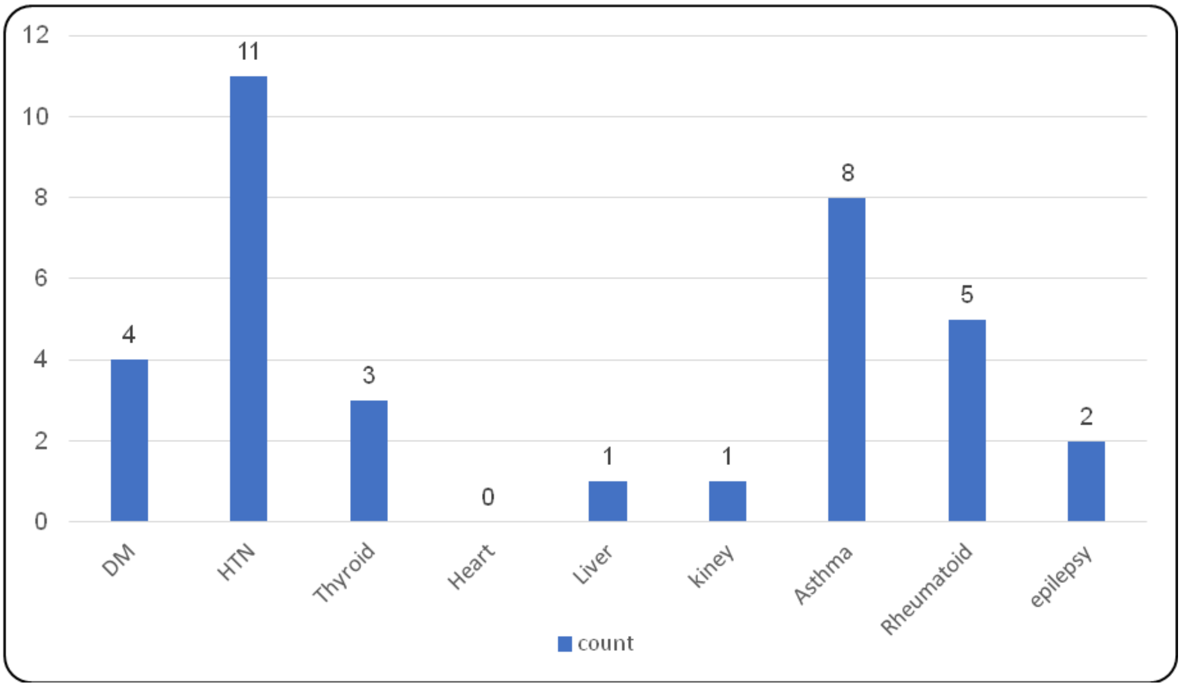


Figure 8:Chronic diseases of mothers

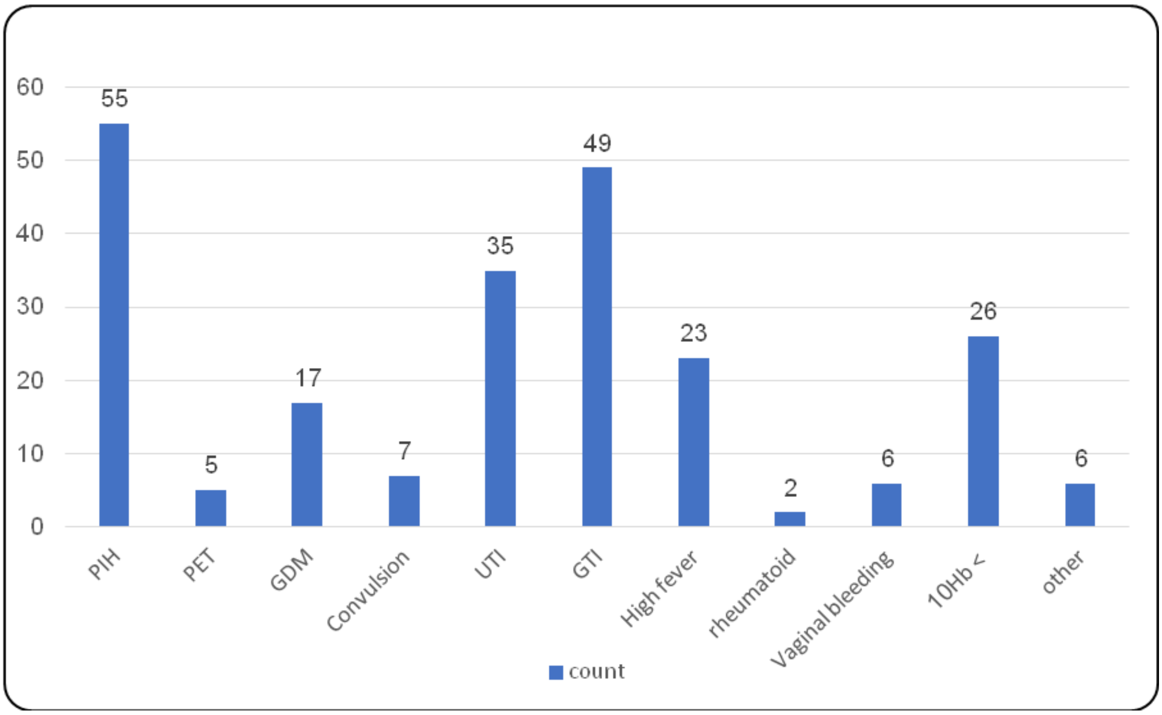


Figure 9: Maternal complications and diseases during pregnancy

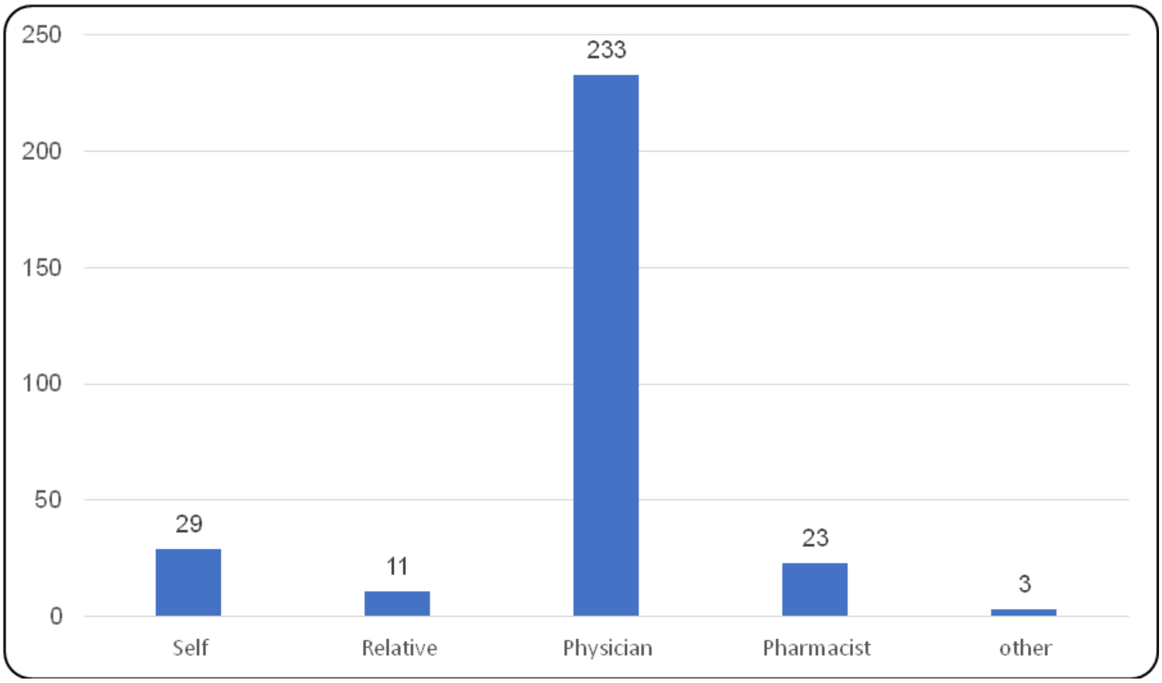


Figure 10: Who prescribed the medications for the pregnant women?

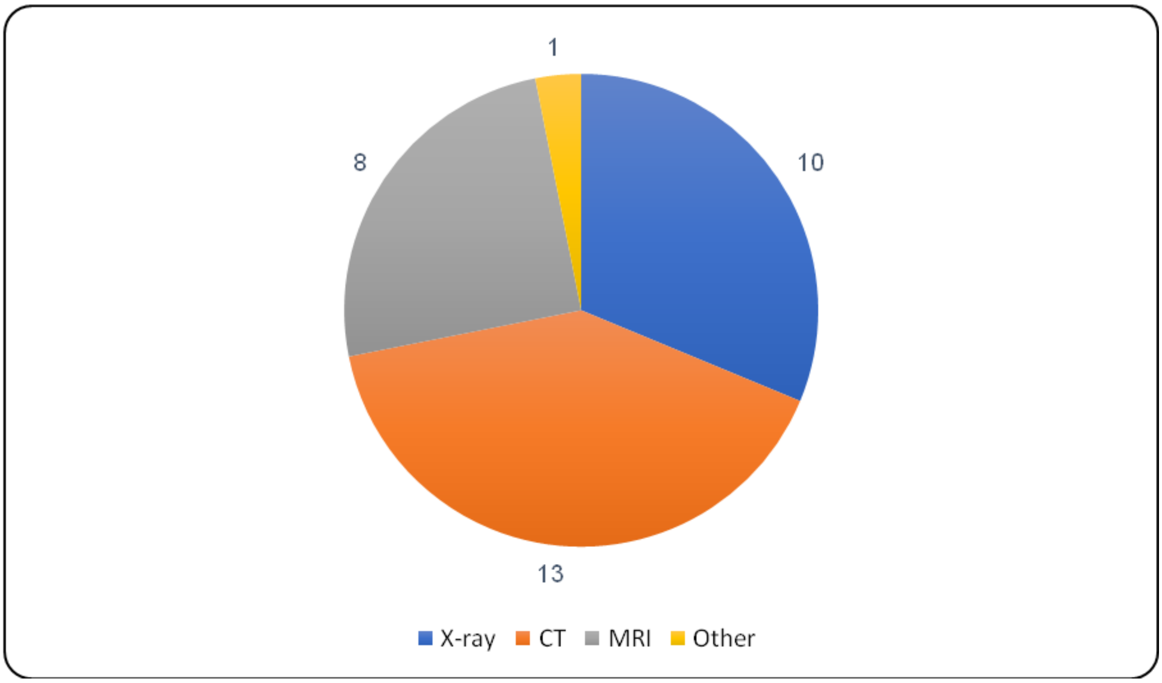


Figure 10:Types of imaging during pregnancy

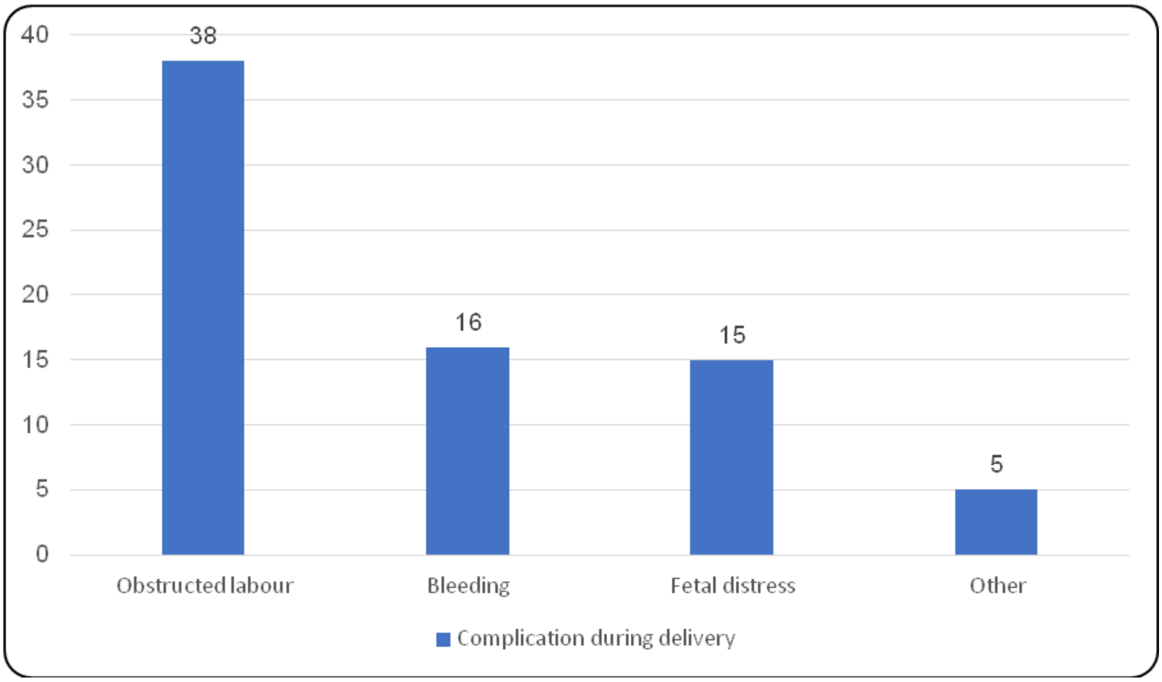


Figure 11: Complications during delivery

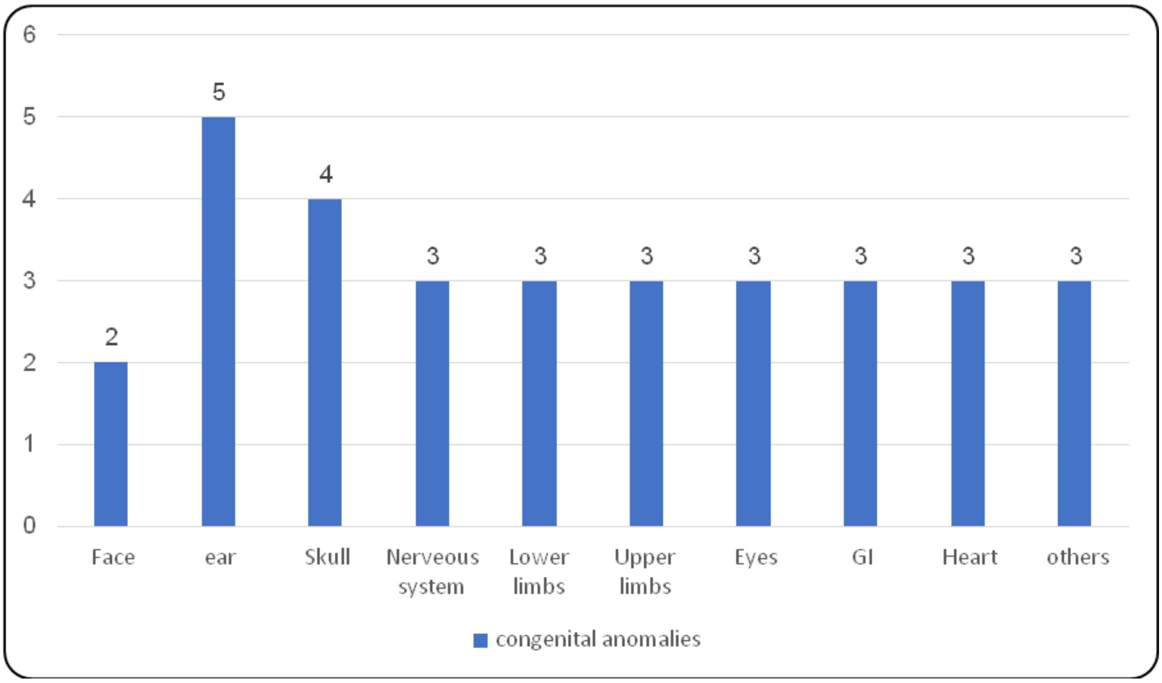


Figure 12:Distribution of congenital anomalies

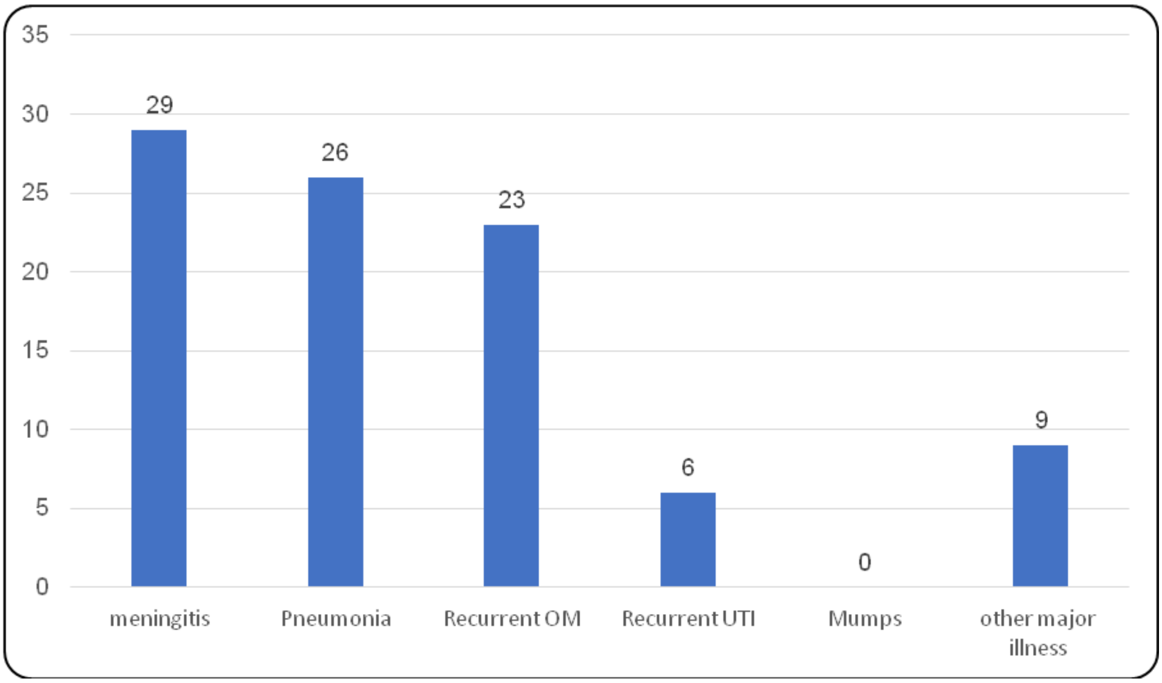


Figure 13:Causes of child serious illness

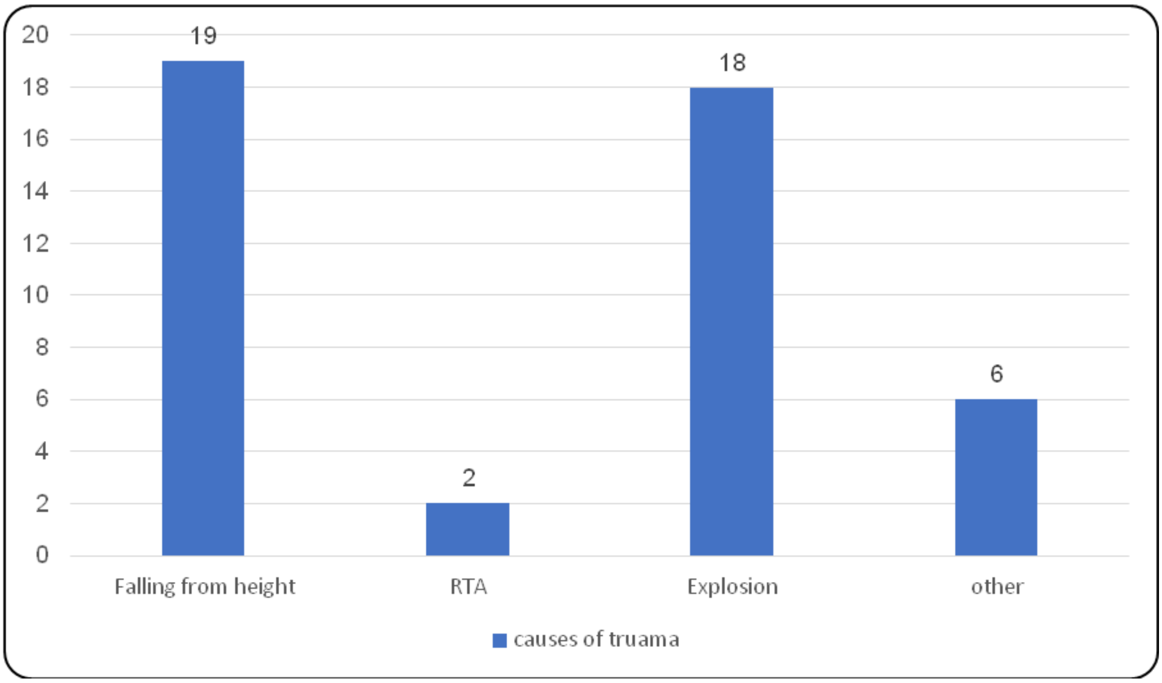


Figure 14: Causes of child trauma

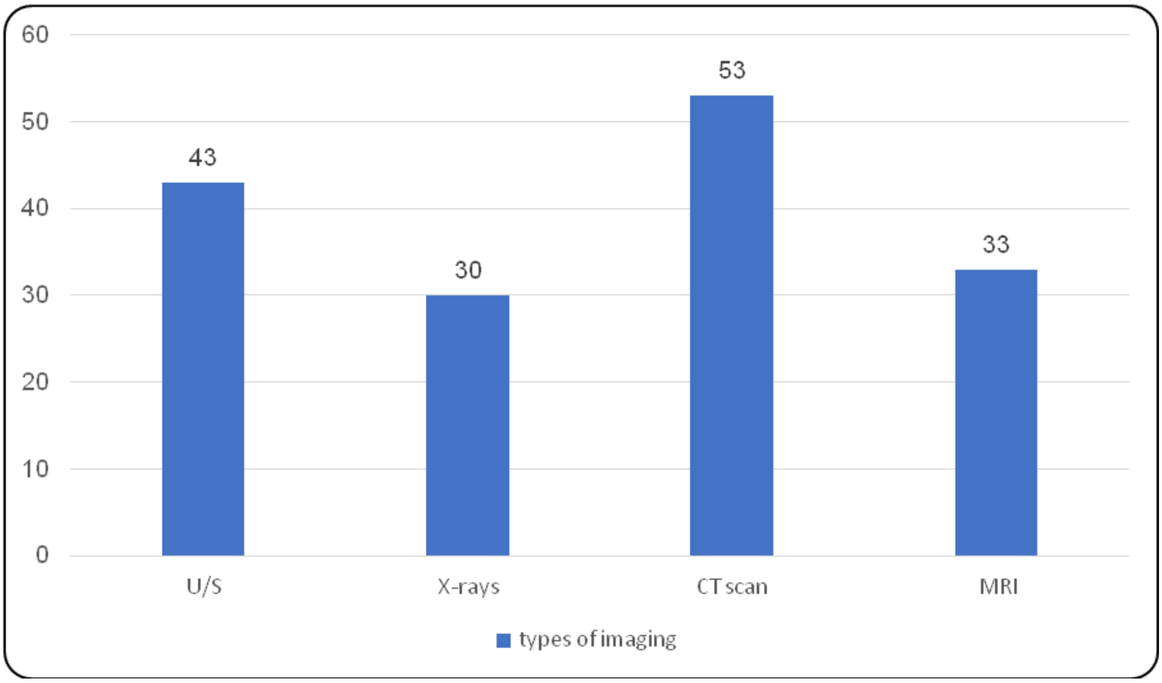


Figure 15: Types of imaging during childhood

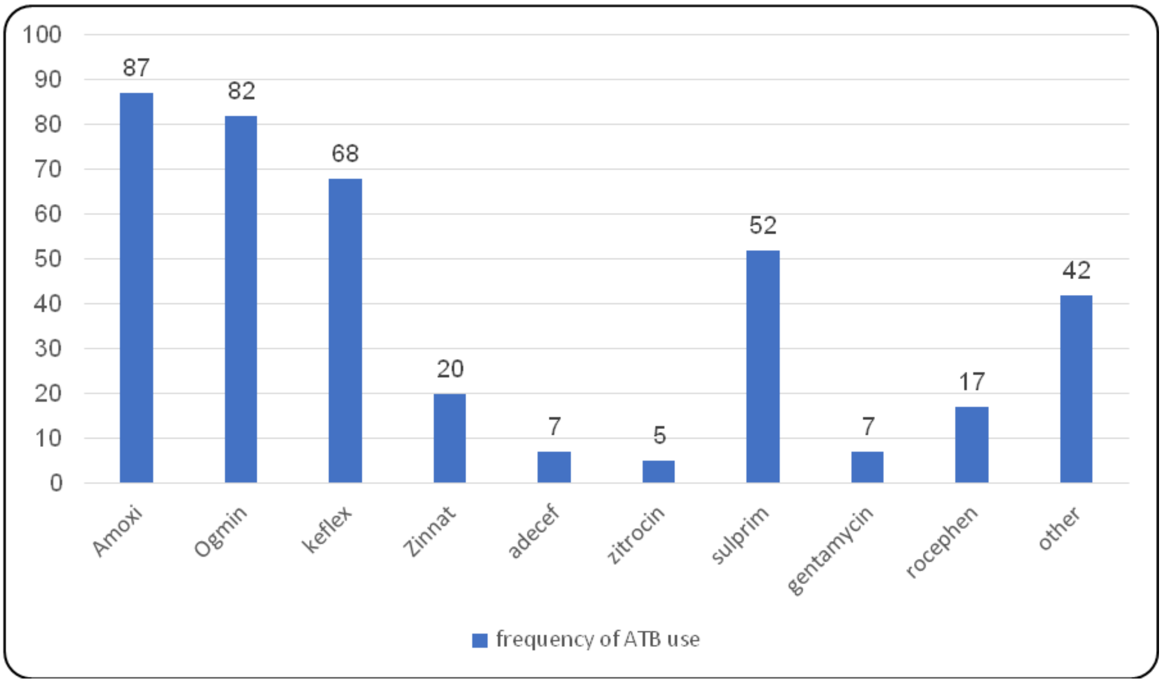


Figure 16: Frequency of most common Antibiotics used during childhood.

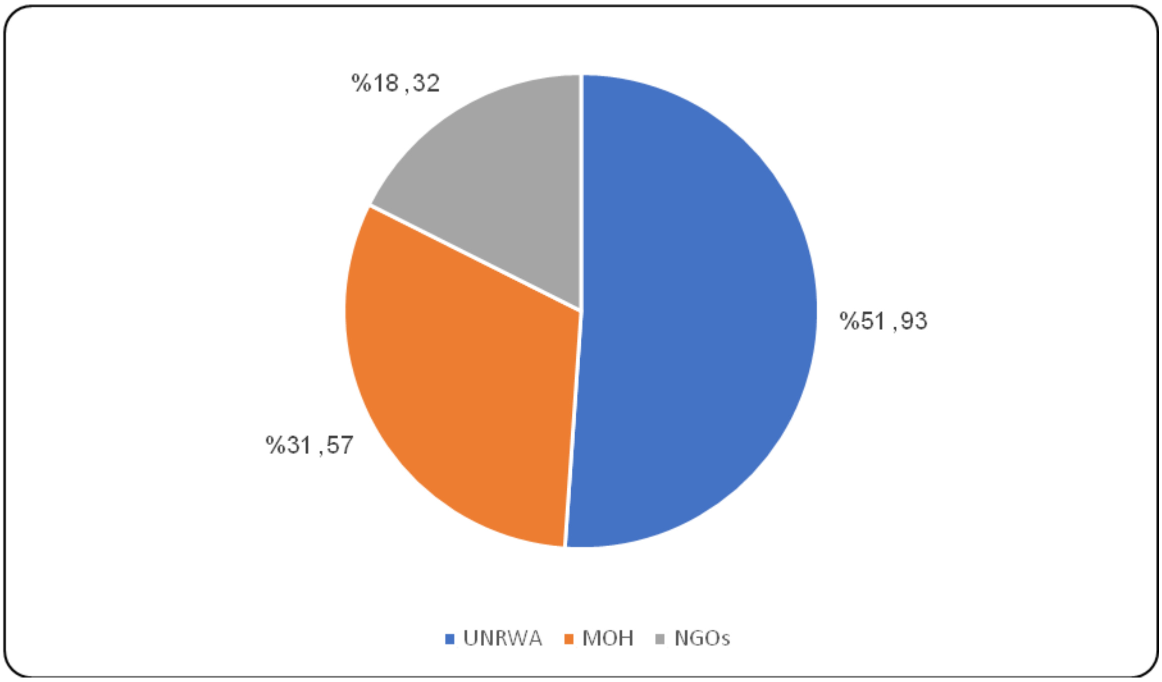


Figure 17: PCC providers

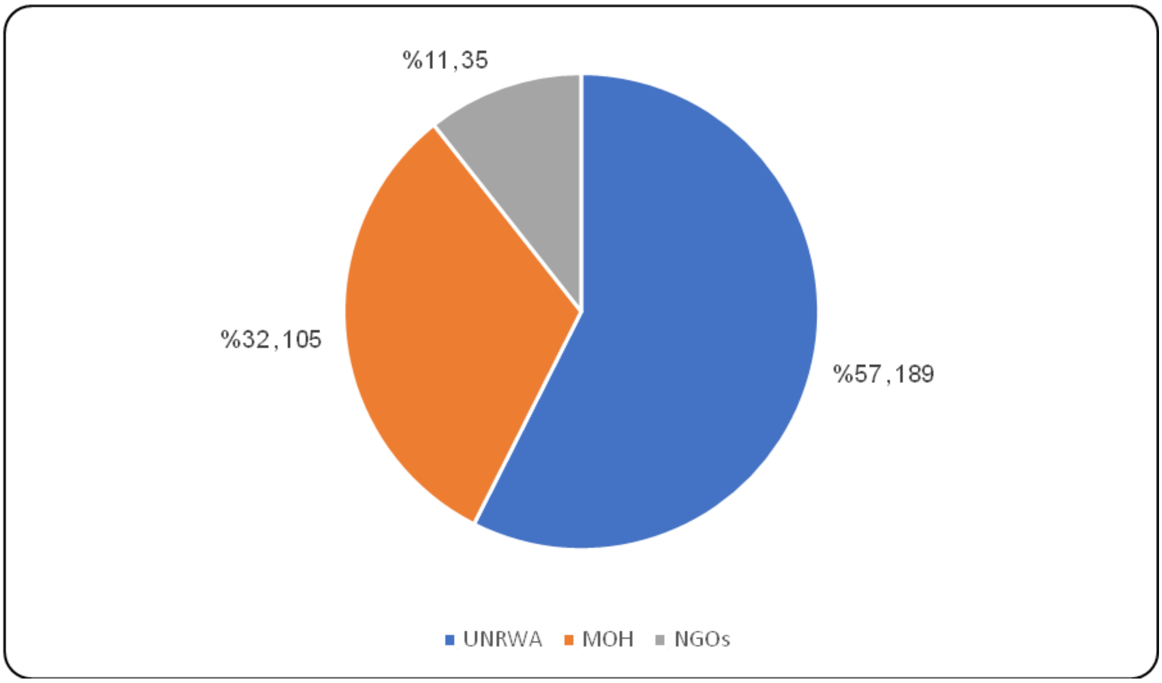


Figure 18:ANC providers

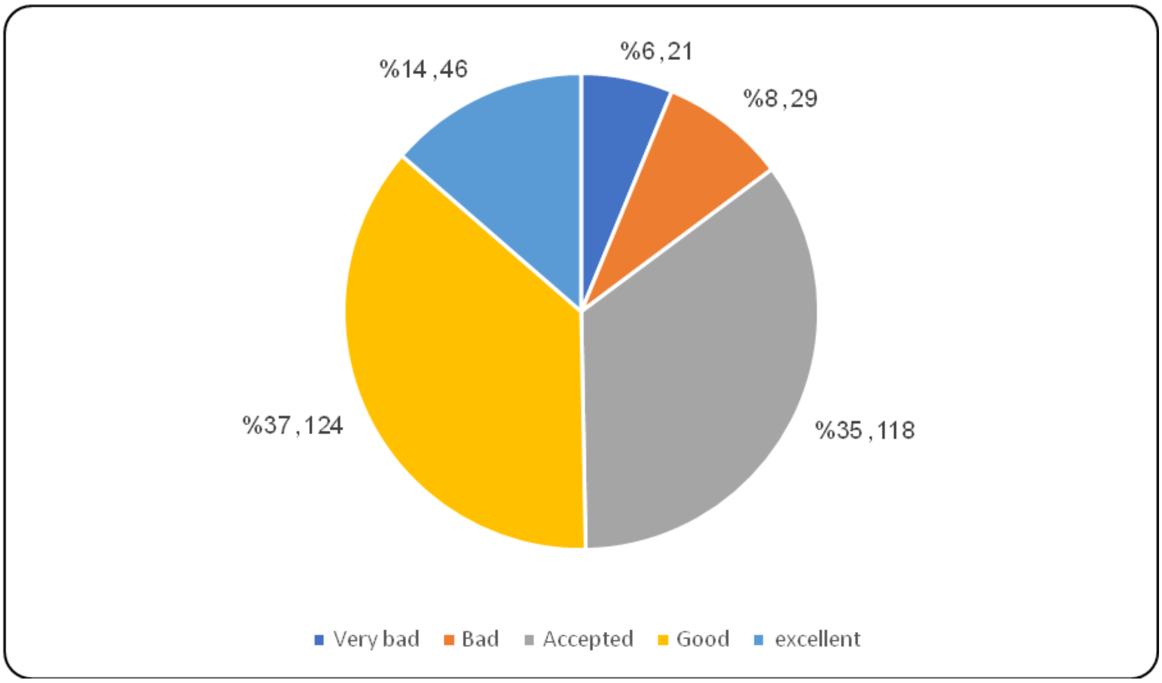


Figure 19:Quality of care during delivery perceived by caregiver.

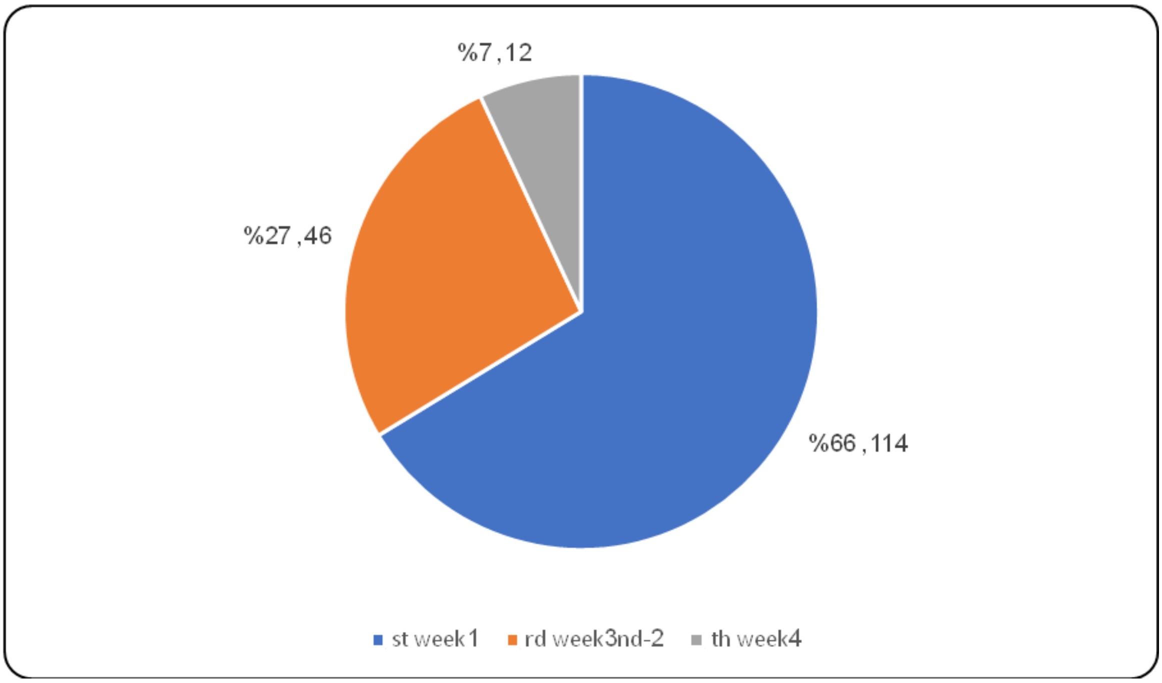


Figure 20: Timing of PNC

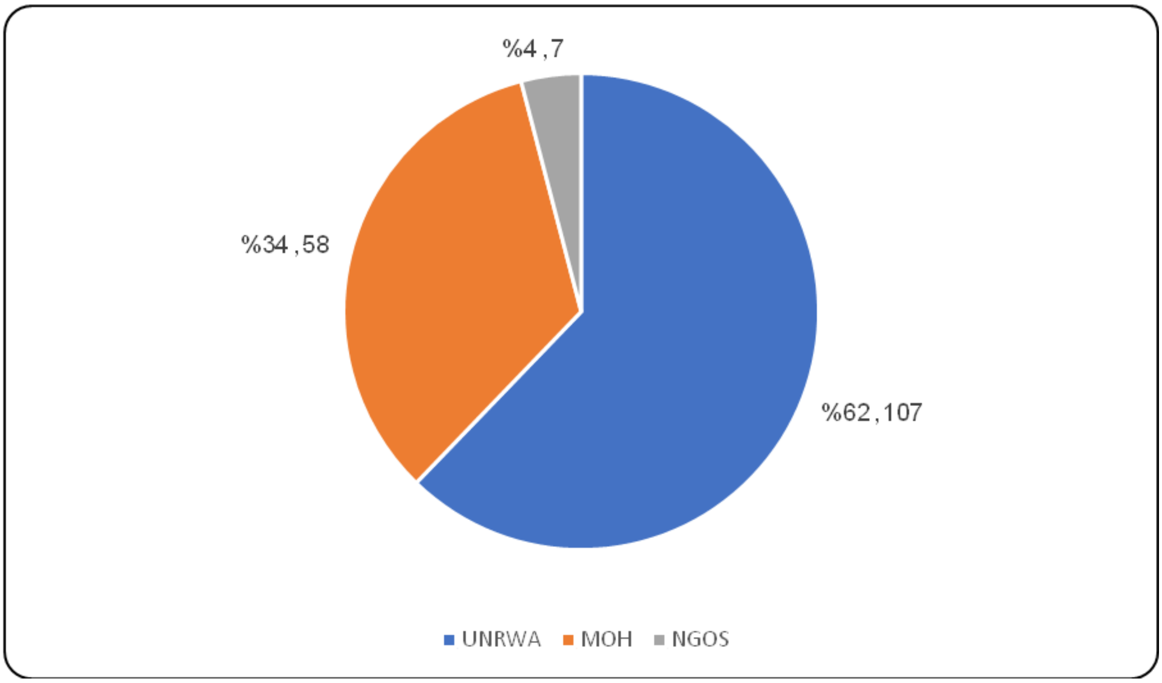


Figure 21: PNC providers

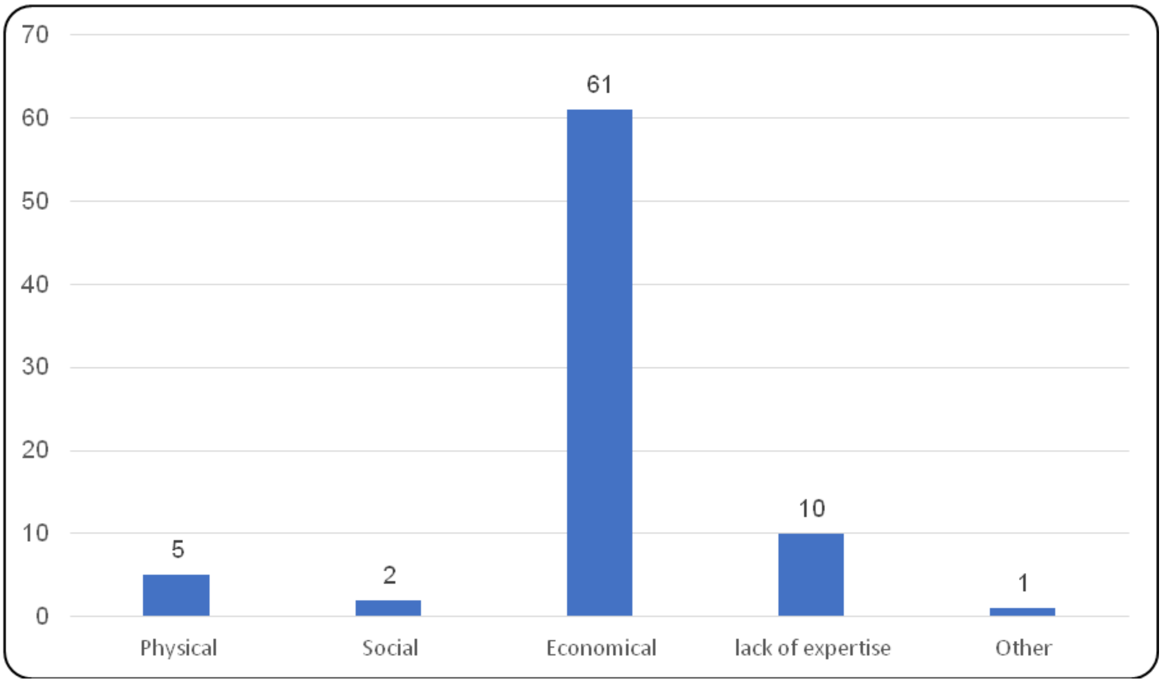


Figure 22: Barrier to health care services

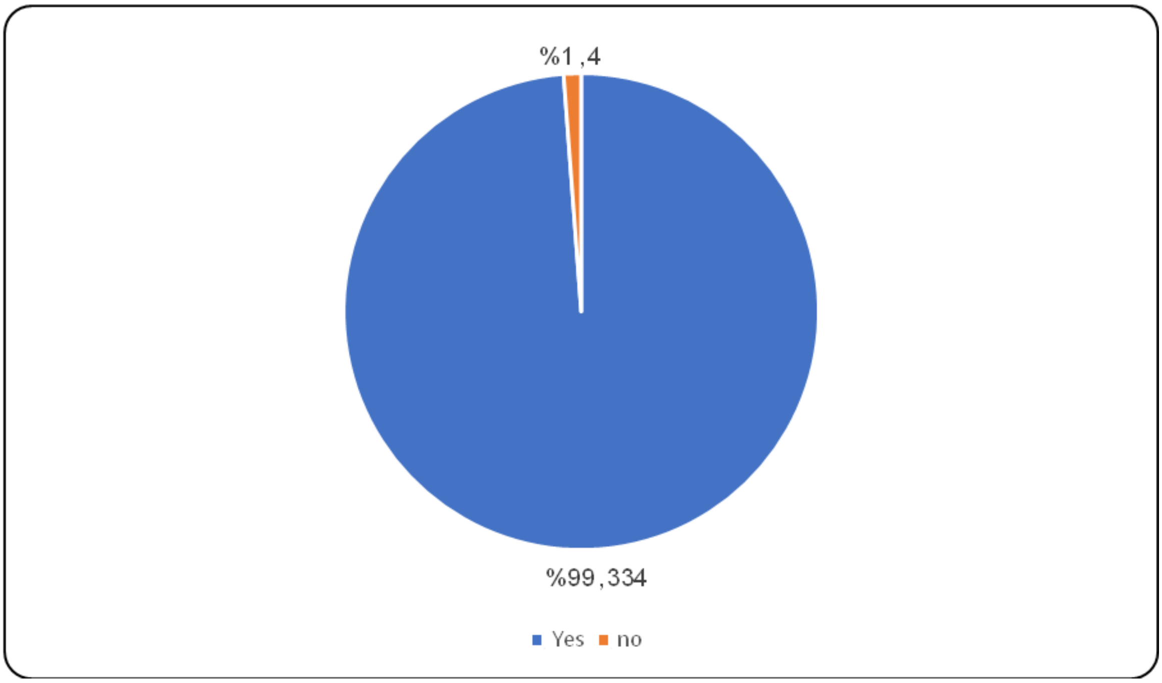


Figure 23: Completeness of vaccine schedule

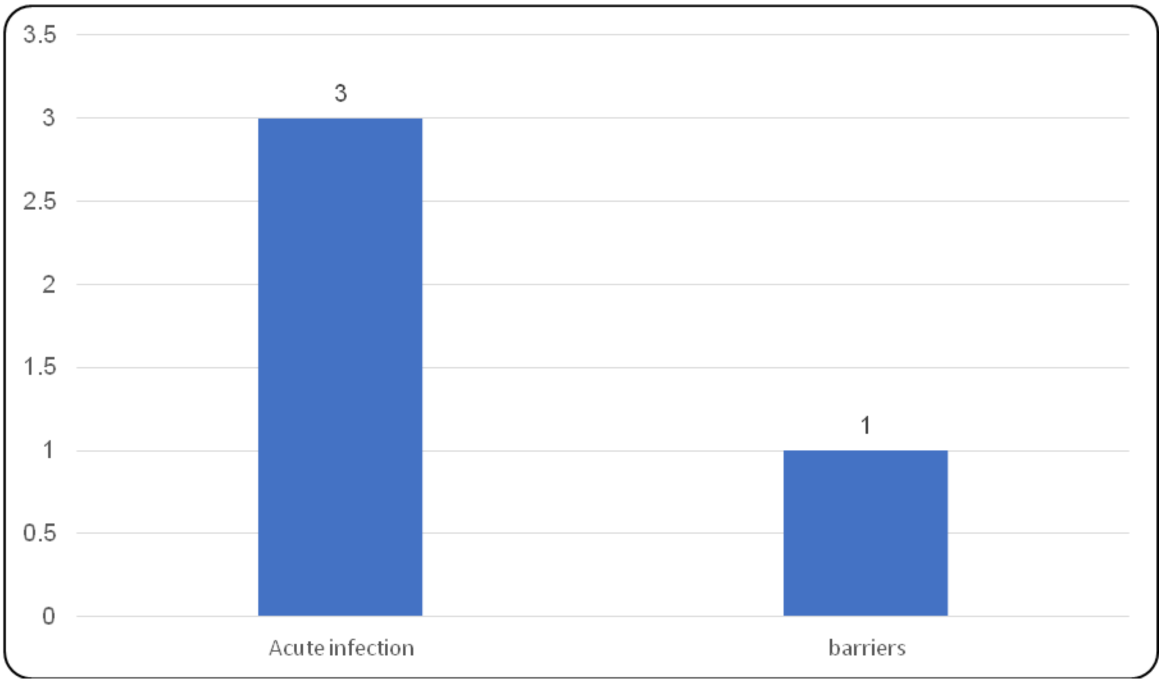


Figure 24: Causes of vaccine defaulters

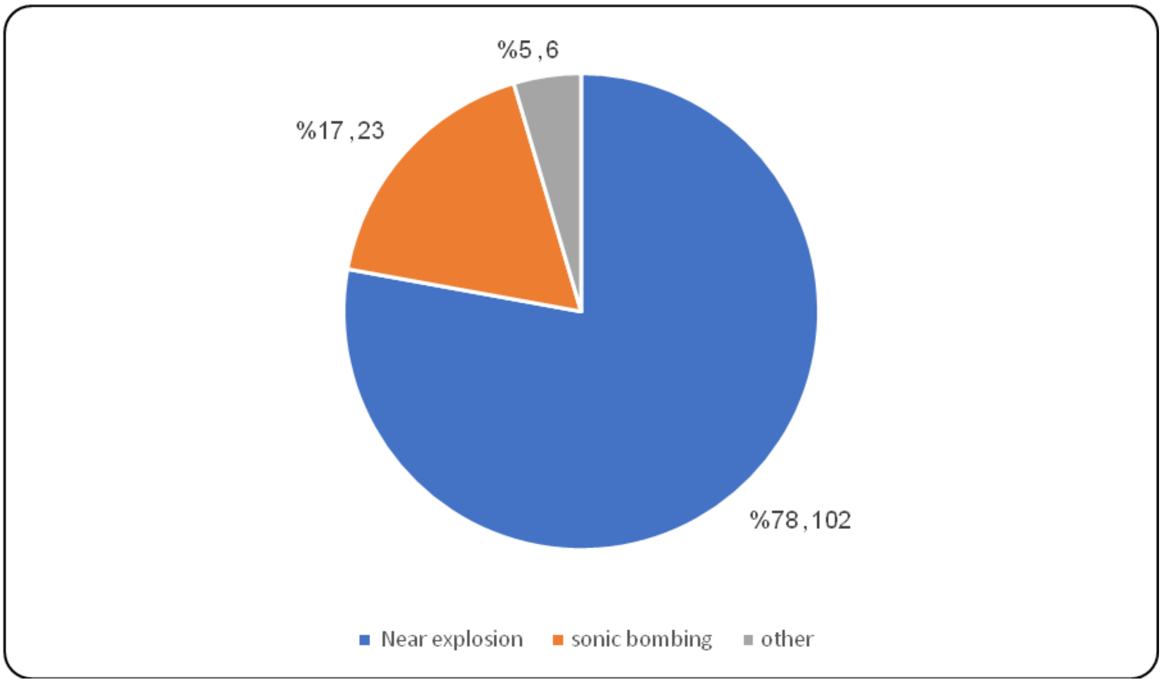


Figure 25: Source of very loud noise even once

Table 19: Completeness of ANC visits

Activity	BP measurement	Urine analysis	Hb level	height	Ultrasound	Breast exam	Fetal monitoring	Medical examination
Yes	316	324	323	289	216	208	308	214
No	5	3	4	4	77	85	10	60
Don't remember	8	2	2	2	36	36	11	55

Table 20: Relationship between PIH, aspirin and low birth weight

Independent variables	Category	PIH cases		No PIH		Chi	P value	OR CI
		NO	%	NO	%			
Aspirin use in pregnancy	Yes	16	29.1	18	6.4	26.3	0.000*	6.040 (2.845-12.821)
	No	39	70.9	265	93.5			
Low birth weight	Yes	15	27.3	26	9.2	14.1	0.001*	3.707 (1.809-7.596)
	No	40	72.7	257	90.8			

* Significant relationship

Table 21: Relationship between ANC, low birth weight and gestational age

dependent variables	Category	ANC		t test	P value
		Yes	NO		
Birth weight	Mean	3037.33 grams	2522.22 grams	2.56	0.011*
Gestational age	Mean	37.7 weeks	36.56	1.498	0.135

* Significant relationship

Annex 5: Questionnaire

Risk Factors of Hearing Impairment Among Infants and Toddlers in the Gaza Strip: A Case Control Study

Dear participant:

I am Dr.Randa Radi, a student at the master degree of Public Health at Al Quds University, conducting a research study about the possible risks factors of hearing impairment among infants in the Gaza strip. This study is as fulfillment requirement for the master degree of public health.
The aim of the study is to explore the risk factors of hearing impairment among infants. The study is looking ultimately to provide health care providers with recommendations that might help in prevention or decreasing the occurrence of hearing impairment. Identified risky groups can also be targeted by prevention and screening programs aiming at enhancing early detection and intervention.

Approximately 350 children will participate in this study and you have been selected to participate in this study randomly. You have been randomly selected because you meet the study criteria. If you agree to participate, you will be asked to fill an interviewed questionnaire. This will take approximately 20 minutes of your valuable time.
Although your participation in this study is highly appreciated, it is voluntary. You are free not to answer any questions.

Dr.Randa

Name	**Telephone or mobile**
□**Case**	□**Control**
Demographic data (socioeconomic)	
1.Serial number	2.Patient ID / 3.Date of birth
4.Gender of infant □ Male □ Female	
5.Date of interview	6.Respondent □ Mother □ Father □others specify
7.Residency □ North □ Gaza □ Deir Al Balah □ Khanyounis □ Rafah Specify:	
8. Exact Address including neighborhood, town	
9.Locality Type: □Rural □ Urban □camp	
10.Refugee status □Refugee □Non-refugee	
11. Who live with you in the same dwelling? □Nuclear family □Extended family	
12. Number of people lives in the same dwelling? -------------	
13. What kind of dwelling unit does the family live in?	□Villa □House □Apartment □Separate Room □Tent □Marginal □Other / **specify**
14. How many sleeping rooms are used in your dwelling (Exclude Kitchen, Balcones bathrooms even if it is used for sleeping)?	
15. Is your dwelling?	□Owned □Rented □ Family house: Not owned and not rented □ Other / **specify:**
16. What is the main source of drinking water for this household? □ Public water network connected to the house □ Tube Well □ Protected spring □ Rain-fed cistern with internal pipes □ Tankers □ Bottled mineral water □ Purchased gallons □ Other / **specify**	
17. What is the main source of water that you use for other things other than drinking? □ Public water network connected to the house □ Tube Well □ Protected spring □ Rain-fed cistern with internal pipes □ Tankers □ Bottled mineral water □ Purchased gallons □ Other / **specify**	
18. Current Mother age -------	20.mother age at delivery of concerned child
19.Mother age at marriage ---------	21. current father age
22.Order among sibling	
23. What is the time space between this child and preceding child in months? Check records	

24. Mother education attained □ Illiterate □ Semi-literate □ Elementary □ Preparatory □ Secondary □ Associated diploma □ Bachelor's degree □ Higher diploma □ Master's degree □ Ph. D.	25. Father education □ Illiterate □ Semi-literate □ Elementary □ Preparatory □ Secondary □ Associated diploma □ Bachelor's degree □ Higher diploma □ Master's degree □ Ph. D
26. What is Mother Employment Status: □ Unemployed □ Employer □ Self employed □ Waged employee	27. what is Father Employment Status: □ Unemployed □ Employer □ Self employed □ Waged employee
28.Mother Occupation---------	29. Father Occupation ---------
30. Does your family receive social assistance? □ Yes □ No	31. If yes, the source is □MOSA □UNRWA □Other **specify**
32. Monthly Family income in NIS from all sources -------------	
33. Monthly Family expenditure----------------	
Family history	
34. Are you, and your partner are relative? □ Yes □ No	35.If yes, specify □ 1st double cousin □ 1st cousin □ 2nd cousin □ same family
36. What is the age at diagnosis in months of the child? -------------------------------------	37.1 at which age do you suspect that your child has difficult hearing? ----------------------------------
38. Other family member diagnosed with hearing impairment □ Yes □ No	
39. in question 38, if yes □ father □ Mother □ Brother □ Sister □ Other **specify**	
40. What is the age at diagnosis of other family member in months?	
41. Did anyone informed you that the hearing impairment can be inherited? □Yes □No	
42. If yes what is the type?	□ autosomal dominant □ autosomal recessive □ X-linked □ Unknown
43. Is there other family member diagnosed with other congenital anomalies? □ Yes □ No	
44. Who is affected in Q43?□ father □ Mother □ Brother □ Sister □ Other	
45. if yes in 43 choose □ heart □kidney □nervous system	□ Gastrointestinal □Motor □vision □other-----
Maternal health and diseases	
46. Does the mother have chronic diseases? □ Yes □ NO	
47. If yes You can choose more than one	□ Cancer

option □ Diabetes □ Hypertension □ Thyroid □ Cardiac disease	□ Renal disease □ Hepatic disease □ Asthma □ Connective tissue diseases □ Other **specify**
48. Was there any complication or illness during pregnancy □ Yes □ No	
49. if yes You can choose more than one option	
□ Pregnancy induced HTN	□High fever
□ PET	□rheumatic disease
□ Gestational diabetes	□vaginal bleeding
□ Convulsion not related to fever	□ hemoglobin below 10
□ Urinary tract infection or genital	□ other specify
□ Vaginal infection	
50. Did you have any medication during pregnancy □ Yes □ NO	

51. if yes, please complete below table, you can choose more than one option

Medication	Who prescribed it	Which trimester	duration
51.1. unknown Antibiotics	□self □relative □physician □pharmacist	□first □second □third	
51.2 Amoxi	□self □relative □physician □pharmacist	□first □second □third	
51.3 keflex	□self □relative □physician □pharmacist	□first □second □third	
51.4 Zinnat	□self □relative □physician □pharmacist	□first □second □third	
51.5 Microfuran	□self □relative □physician □pharmacist	□first □second □third	
51.6 Gentamycine	□self □relative □physician □pharmacist	□first □second □third	
51.7 Clindamycine	□self □relative □physician □pharmacist	□first □second □third	
51.8 Another Antibiotic (specify)	□self □relative □physician □pharmacist	□first □second □third	
51.9 B.aspirin	□self □relative □physician □pharmacist	□first □second □third	
51.10. Heparin or clexan	□self □relative □physician □pharmacist	□first □second □third	

51.11. Progesterone	□self □relative □physician □pharmacist	□first □second □third	
51.12. Other specify	□self □relative □physician □pharmacist	□first □second □third	

52. Have you colored your hair during pregnancy?

53.If yes which trimester □1st □2nd □3rd

54. Have you been exposed to imaging during pregnancy? □ Yes □ NO

55. If yes specify □x-ray □MRI □CT □ other specify

56. If yes which trimester □1st □2nd □3rd

57. Have been exposed to trauma? □ Yes □ NO

58. if yes □RTA □Falling down from height or stairs □ Explosion □ other specify

59. If yes which trimester? □first □second □third

60. Was there an explosion near you during pregnancy? □ Yes □ NO

61. If yes how far in meters?

62. If yes which trimester? □first □second □third

63. Did you take folic acid before pregnancy □ Yes □ NO

64. If yes for how long? In months

65. Did you have any supplements during pregnancy? □ Yes □ NO

You can choose more than one option

Supplement	yes	No	Which trimester	duration
65.1. Folic Acid				
65.2. Iron				
65.3. Omega 3				
65.4 Multivitamins				
65.5 Calcium				
65.6. Other **(specify)**				

Fetal health and diseases

66. what was the delivery mode
□ Normal □ Normal assisted by ventose □ Normal assisted forceps □ C. S

67. Did you develop any complication during delivery? □ Yes □ NO

68. If yes □ Obstructed □ Bleeding □ fetal distress □Other

69. Gestational age in weeks ------------	70. twin or multiple □ Yes □ NO

71. Gestational age □ Premature □ Full term □ Postdate

72. Birth weight in grams----------------	73. Was the infant admitted to NICU □ Yes □ NO

74. If yes for how long in days? ------------

75. if yes, what is the cause of admission to NICU You can choose more than one option □ Sepsis □ prematurity □ Respiratory distress	□ Low birth weight □ Asphyxia □ Don’t know □ Kidney disease □ Other **specify**
76. Did the infant need mechanical ventilation? □ Yes □ NO	77. If yes for MV how long in days? ------------------------

78. Did the infant have neonatal jaundice? □ Yes □ NO

79. If yes, for how long in weeks? ----------

80. What is cause of jaundice?	□ Physiological □ breast feeding □ Rh incompatibility □ infection □ head trauma □ other **specify** □ Unknown
81. If yes, how it was treated? □ conservative □ phototherapy □ blood exchange □ **other specify**	
82. Does the infant have any congenital abnormalities □ Yes □ NO	
83. If yes, please where? You can choose more than one option □Face □Ear □Skull □Upper limbs □Lower limbs □Cardiac □Neural tube defect □GI system □Renal □Other specify	
84. Did the child have major infant illness □ Yes □ NO	85. if yes □ Meningitis □ Encephalitis □ pneumonia □ Mumps □ Otitis media □ Other **specify**
86. If yes, did the infant need hospital admission? □ Yes □ NO	
87. Did the infant expose to a serious trauma? □Yes □NO	
88.If yes, please specify □ Falling from height □ RTA, □ Bombing, explosion □ Other specify	
89. Use of ototoxic medication □ yes □ no □ Unknown	
90. Had the child been exposed to imaging? □yes □No	
91. If yes **specify** □ultrasound □x-ray □ MRI □ CT	
92. If yes how many times? -----------	
93. Had your child received antibiotic during the first 3 year of his/her life? □Yes □No	
94. If yes, how many times? -------------	
95. If yes, do you know the name of antibiotics? You can choose more than one option □Amoxi □Ogmin □Keflex □Zinnat □Adecef □azimex □Ultrasept □Gentamycin □Rocephin □Other (specify)	
96. If the child is less than six months old, what is the type of feeding? □ Exclusive breast feeding □ Formula □ Mixed	97. If the child is above 6 months, what was the type of feeding during the first 6 months? □ Exclusive breast feeding □ Formula □ Mixed
Health services Provision	
98. Is this pregnancy was planned? □Yes □NO	
99. if yes was PCC received □ Yes □ NO	100. If yes where □ UNRWA □ MOH □ NGOs □ Other specify
101. AN received □ Yes □ NO	102. if yes registered at □ First □ Second □ Third trimester
103. If yes □ UNRWA □ MOH □ NGOs □ Other specify	
104. Number of antenatal visits -------------	
105. As part of your antenatal care during this pregnancy, were any of the following done at	

least once:			
	Yes	No	Don't remember
105.1 Blood pressure			
105.2 Urine sample			
105.3 Blood sample			
105.4 Height measurement			
105.5 Ultrasound			
105.6 Breast Screening			
105.7 Fetal heart monitoring			
105.8 Full medical exam			

106. Did you have Ultrasound in pregnancy? □Yes □NO

107. If yes, how many times?

108. What was the result of your ultrasound? □ Normal □Abnormal

109. If abnormal ultrasound please specify:

110. Delivery at □ hospital □ NGOs □ House □ Other

111. Which of the following best describes your experience during delivery?

- □ Services were very poor
- □ Services were poor
- □ Reasonable
- □ good
- □ excellent

112. Postnatal received □ Yes □ No	113. If yes □Within first week □ 2nd to 3rd week □ 4th week
114. How many visits?	115. If yes □ UNRWA □ MOH □ NGOs □ Other specify

116. Had the new born been examined during the postnatal care? □ Yes □ NO

117. If yes, what was the feedback from health provider?

- □ No feedback
- □ Normal
- □ Abnormal **specify**

118. Did the infant have all the vaccination up to date □ Yes □ No	119. If no, why? □Acute illness □Chronic illness □barriers to access □ Other(specify)

120. Is there any barrier to health care services
□ Yes □ No

121. If yes □ Physical □ Social □ Economic □Expertise
□ other **specify**

Environmental condition

122. Had the child been exposed to continuous loud noise □ Yes □ No

123. If yes specify □ Near factory □ Music □Traffic □ generators □other **specify**

124. Have the infant been exposed to very loud noise? □ Yes □ No

125. if yes specify □ Explosion □ Trauma □ Sonic bombing □other **specify**

126. If the child was exposed to Explosion, how far it was in meters? ---------

127. Is the child exposed to smoking? □ yes □ NO

128. If yes □ during fetal life □ during infancy □ both

129. Does the father smoke? □ Yes, mostly Cigarettes □ Yes, mostly pipeà □ Yes, mostly narghileà □ Yes, cigarettes and narghile □ Smoked in the past and quit smoking □ Does not smoke and never smoked	130. Does the mother smoked? □ Yes, mostly Cigarettes □ Yes, mostly pipeà □ Yes, mostly narghileà □ Yes, cigarettes and narghile □ Smoked in the past and quit smoking □ Does not smoke and never smoked
131. Is there a factory near the house? □ yes □ NO	
132. If yes, what is the type of factory? □ food □ detergents □batteries □ other **specify**	
133. Is the child being exposed frequently to chemicals such as sprays, detergent, hair dies, pesticides or any vapors during pregnancy or after delivery □ yes □ NO	
134. If yes □insecticides □ pesticides□ detergents□ Other **specify**	
135.Is the house well ventilated □ yes □ N0	
136. Is the house having enough sun rays □ yes □ No	
137. Is there any asbestos in house? □ yes □ No	
138. When was your house last painted?	
139. Is there any Pumping in nearby area? □ yes □ No	
140. If yes how meters far?	
141. Is there any trash container near your house? □ yes □ No	
142. If yes how meters far?	
143. Is there any petrol station near your house? □ yes □ No	
144. If yes how meters far?	

Risk Factors of Hearing Impairment Among Infants and Toddlers in the Gaza Strip: A Case Control Study

عوامل الخطر لفقدان السمع عند الأطفال أقل من 3 سنوات في قطاع غزة

عزيزتي المشتركة:

أنا الباحثة د.رندا راضي ، طالبة في برنامج ماجستير الصحة العامة في جامعة القدس. أقوم حاليا" بعمل بحث حول الأسباب أو العوامل المحتملة التي قد تسبب خلل في حاسة السمع عند الأطفال أقل من 3 سنوات في قطاع غزة. هذه الدراسة هي متطلب للحصول على درجة الماجستير في الصحة العامة.

الهدف من هذه الدراسة هو تحديد عوامل الخطر التي قد تؤثر على حاسة السمع عند الأطفال. نتائج هذه الدراسة قد تساعد في وضع التوصيات التي قد تحد من حدوث مشاكل السمع عند الأطفال. نتائج هذا البحث ستساعد في التعرف على أكثر الفئات عرضة لمشاكل السمع و من ثم يتم التركيز عليها من خلال التقصي و الكشف و التدخل المبكر.

سيتم مقابلة قرابة 350 عائلة في هذا البحث. تم اختياركم عشوائيا لأن شروط البحث تنطبق عليكم. إذا وافقت على المشاركة ، سيتم الطلب منك الإجابة على بعض الأسئلة الموجودة في هذا الاستبيان. يستغرق هذا الاستبيان حوالي 20 دقيقة.

مشاركتك في البحث اختيارية و لكننا نقدر مشاركتك و الوقت الثمين الذي ستمنحنا اياه

لك مطلق الحرية في الإجابة أو الامتناع عن إجابة أي سؤال.

د. رنــــــدا راضــي

<table dir="rtl">
<tr><td>الاسم</td><td colspan="2">رقم الجوال (التلفون)</td></tr>
<tr><td>حالة تعاني من صعوبة في السمع</td><td colspan="2">حالة لا تعاني من صعوبة في السمع</td></tr>
<tr><td colspan="3">المعلومات الديموغرافية</td></tr>
<tr><td>1.تاريخ الميلاد
اليوم التاريخ السنة</td><td>2.رقم الهوية</td><td>3.الرقم المتسلسل</td></tr>
<tr><td colspan="3">4. النوع الاجتماعي □ذكر □ أنثى</td></tr>
<tr><td colspan="2">5.تاريخ المقابلة</td><td>6. مقدم المعلومات □الأب □ الأم□ أخرون حدد</td></tr>
<tr><td colspan="3">7. مكان السكن □شمال غزة □غزة □دير البلح □ خانيونس □ رفح</td></tr>
<tr><td colspan="3">8. العنوان بالتفصيل --</td></tr>
<tr><td colspan="3">9.نوع منطقة السكن □ريفي □ مدني □ مخيم</td></tr>
<tr><td colspan="3">10. الحالة □ لاجئ □ غير لاجئ</td></tr>
<tr><td colspan="3">11. من يسكن معك نفس السكن ؟ □ العائلة النووية □ العائلة الممتدة</td></tr>
<tr><td colspan="3">12. عدد الأشخاص الذين يسكنون معك في نفس المنزل-----------</td></tr>
<tr><td>13. ما نوع المنزل الذي تسكنه؟</td><td colspan="2">□ منزل منفصل
□ شقة سكنية
□ فيلا
□ غرفة منفصلة
□ خيمة
□ تجمع حدودي
□ أخرى حدد------------</td></tr>
<tr><td colspan="3">14. عدد غرف النوم في المنزل (باستثناء المطبخ و الحمامات و البلكونات حتى لو كانت تستخدم للنوم)
------------</td></tr>
<tr><td>15 هل مسكنك ؟</td><td colspan="2">□ ملك لك
□ مستأجر
□ بيت العائلة
□ أخرى حدد --------</td></tr>
<tr><td colspan="3">16. ما هو المصدر الرئيسي للماء المستخدم للشرب؟
□ مياه البلدية الواصلة عبر الشبكة الاعتيادية
□ بئر داخلي في المنزل
□ مياه تشترى من سيارات محطات التحلية
□ جالونات تعبئ من الدكاكين
□ مياه معدنية
□ تجمع مياه الأمطار
□ أخرى حدد--------------</td></tr>
<tr><td colspan="3">17. ما هو المصدر الرئيسي للماء المستخدم لأغراض غير الشرب؟
□ مياه البلدية الواصلة عبر الشبكة الاعتيادية</td></tr>
</table>

□ بئر داخلي في المنزل □ مياه تشترى من سيارات □ جالونات تعبئ من الدكاكين □ مياه معدنية □ تجمع مياه الأمطار □ أخرى حدد --------------	
18. عمر الأم حاليا"--------------	19. عمر الأم عند الزواج------------
20. عمر الأم عند انجاب هذا الطفل -- -----------	21. عمر الأب -----------
22.ما هو ترتيب هذا الطفل بين الأبناء؟ -------------	
23. ما هي المدة الزمنية بين هذا الطفل و الطفل السابق ؟ (ان لم يكن الأول) ------------	
24.ما هو المستوى التعليمي الذي أكملته الأم؟ □ أمية □ تستطيع القراءة و الكتابة □ ابتدائي □ اعدادي □ ثانوي □ دبلوم □ بكالوريوس □ دبلوم عالي □ ماجستير □ دكتوراة	25.ما هو المستوى التعليمي الذي أكمله الأب؟ □ أمي □ يستطيع القراءة و الكتابة □ ابتدائي □ اعدادي □ ثانوي □ دبلوم □ بكالوريوس □ دبلوم عالي □ ماجستير □ دكتوراة
26.ماهو عمل الأم حاليا" ؟ □ لا تعمل □ صاحب عمل □ مستخدم بأجر □ عضو أسرة بدون أجر	27. ما هو عمل الأب حاليا" ؟ □ لا يعمل □ صاحب عمل □ مستخدم بأجر □ عضو أسرة بدون أجر
28. وظيفة الأم -------------	29. وظيفة الأب ------------
30. هل تحصل العائلة علي مساعدات اجتماعية ؟ □نعم □ لا	31. اذا كانت الإجابة نعم، ما هو مصدر هذه المساعدات؟ □وزارة الشئون الاجتماعية □ وكالة الغوث □ أخرى حدد--------
32. ما هو دخل العائلة الشهري بالشيكل؟ -------------------	
33. ما هو تقديرك لمجموع مصروفاتك خلال الشهر؟ --------------------	
التاريخ العائلي	
34.هل انت و زوجك أقرباء؟ □ نعم □ لا	35. اذا كانت الاجابة بنعم ما نوع القرابة: □ أولاد عم و خالة أو أولاد خال و عمة □ أولاد العم أو الخال أو الخالة أو العمة (من الدرجة الأولى) □ ابن عم الوالد (من الدرجة الثانية) □ نفس العائلة
36.ما هو عمر الطفل عند التشخيص (للحالات المصابة فقط) -------------	37.1. على أي عمر شعرتي بأن طفلك يعاني من مشكلة في السمع؟ (للحالات المصابة فقط) -----------------------
37.2. ما مدى استجابة طفلك للأصوات	□ (من عمر يوم لـ3 أشهر) يتفاعل مع الصوت □ نعم □ لا □ (من عمر 4-6 أشهر) ينتبه لأصوات الموسيقى□ نعم □ لا

<table>
<tr><td></td><td>□ (من عمر 7-12 شهر) يفهم الكلمات الشائعة مثل عصير، بوت) □ نعم □ لا
□ (من عمر سنة إلى سنتين) يعرف أسماء بعض أجزاء الجسم و يشير إليها) □ نعم □ لا</td></tr>
<tr><td colspan="2">38. هل هناك أحد من أفراد الأسرة يعاني من صعوبة في السمع؟ □ نعم □ لا</td></tr>
<tr><td colspan="2">39. اذا كانت الإجابة بنعم في س 38 من المصاب ؟ □الأب □ الأم □ أخ □ أخت □ العائلة</td></tr>
<tr><td colspan="2">40.على أي عمر تم تشخيص المصاب في س39 ؟ ---------------</td></tr>
<tr><td colspan="2">41. هل لديك أي معلومات تفيد بأن صعوبة السمع لدى ابنك أ بنتك (للحالات المصابة فقط) هو مرض وراثي ؟
□ نعم □ لا</td></tr>
<tr><td>42. أذا كانت الاجابة ب نعم في س 41 ، هل تعلم ما هو نوع المرض الوراثي؟</td><td>□ صفة سائدة
□ صفة متنحية
□ مربوطة بالكروموسوم X
□ لا أعلم</td></tr>
<tr><td colspan="2">43. هل يعاني أي فرد من العائلة من عيوب أو أمراض وراثية ؟ □ نعم □ لا (إذا كانت الإجابة بلا انتقل للسؤال 46)</td></tr>
<tr><td colspan="2">44. من هو المصاب ؟ □الأب □ الأم □ أخ □ أخت □ العائلة</td></tr>
<tr><td>45. اذا كانت الاجابة بنعم ما هو المرض؟
□ مشاكل في القلب
□ مشاكل في الكلية
□ مشاكل في الجهاز العصبي</td><td>□ مشاكل في الجهاز الهضمي
□ مشاكل في الجهاز الحركي
□ أخرى حدد ------------</td></tr>
<tr><td colspan="2">العوامل المتعلقة بصحة و أمراض الأم</td></tr>
<tr><td colspan="2">46 هل تعاني الأم من أي أمراض مزمنة؟ □ نعم □ لا</td></tr>
<tr><td>47.اذا كانت الإجابة بنعم ما هو المرض؟ يمكن اختيار أكثر من إجابة
□ مرض السكري
□ ارتفاع الضغط
□ أمراض الغدة الدرقية
□ أمراض القلب</td><td>□ أمراض الكبد
□ أمراض الكلية
□ الأزمة الصدرية
□ الروماتيزم
□ تشنجات
□ أخرى حدد -------</td></tr>
<tr><td colspan="2">48. هل عانت الأم من أي أمراض أو مضاعفات خلال فترة الحمل ؟ □ نعم □ لا</td></tr>
<tr><td colspan="2">49. اذا كانت الإجابة بنعم في س 48 ما هو المرض؟ يمكن اختار أكثر من إجابة</td></tr>
<tr><td>المرض أو المضاعفة</td><td>أي فصل(ثلث) من الحمل</td></tr>
<tr><td>□ ضغط حمل</td><td>□ الأول □ الثاني □ الثالث</td></tr>
<tr><td>□ تسمم الحمل</td><td>□ الأول □ الثاني □ الثالث</td></tr>
<tr><td>□ سكري الحمل</td><td>□ الأول □ الثاني □ الثالث</td></tr>
<tr><td>□ تشنجات غير مصاحبة لارتفاع الحرارة</td><td>□ الأول □ الثاني □ الثالث</td></tr>
<tr><td>□ التهابات في مجرى البول</td><td>□ الأول □ الثاني □ الثالث</td></tr>
<tr><td>□ التهابات نسائية</td><td>□ الأول □ الثاني □ الثالث</td></tr>
<tr><td>□ سخونة عالية</td><td>□ الأول □ الثاني □ الثالث</td></tr>
<tr><td>□ أمراض روماتيزم</td><td>□ الأول □ الثاني □ الثالث</td></tr>
<tr><td>□ نزيف مهبلي</td><td>□ الأول □ الثاني □ الثالث</td></tr>
<tr><td>□ فقر دم مستوى الهيموجلوبين أقل أو يساوي 10</td><td>□ الأول □ الثاني □ الثالث</td></tr>
<tr><td>□ أخرى حدد-----------</td><td>□ الأول □ الثاني □ الثالث</td></tr>
</table>

50. هل تناولت اي دواء خلال فترة الحمل ؟ □ نعم □ لا

51. اذا كانت الاجابة بنعم أكمل الجدول الاتي (يمكن اختيار أكثر من إجابة)

الدواء	من وصف لك العلاج	المدة الزمنية	أي فصل(ثلث) من الحمل
□ 51.1 مضاد حيوي لا أعرف اسمه	□شخصي □ قريب □ طبيب □ صيدلي □أخرى		□ الأول □ الثاني □ الثالث
□ 51.2 اموكسيسيلين	□شخصي □ قريب □ طبيب □ صيدلي □أخرى		□ الأول □ الثاني □ الثالث
□ 51.3 كفليكس	□شخصي □ قريب □ طبيب □ صيدلي □أخرى		□ الأول □ الثاني □ الثالث
□ 51.4 زينات	□شخصي □ قريب □ طبيب □ صيدلي □أخرى		□ الأول □ الثاني □ الثالث
□ 51.5 ميكروفيران	□شخصي □ قريب □ طبيب □ صيدلي □أخرى		□ الأول □ الثاني □ الثالث
□ 51.6 جينتاميسين	□شخصي □ قريب □ طبيب □ صيدلي □أخرى		□ الأول □ الثاني □ الثالث
□ 51.7 كلنداميسين	□شخصي □ قريب □ طبيب □ صيدلي □أخرى		□ الأول □ الثاني □ الثالث
□ 51.8 أخرى مضاد حيوي حدد ----	□شخصي □ قريب □ طبيب □ صيدلي □أخرى		□ الأول □ الثاني □ الثالث
□ 51.9 اسبرين	□شخصي □ قريب □ طبيب □ صيدلي □أخرى		□ الأول □ الثاني □ الثالث
□ 51.9 هيبارين أو كليكسان	□شخصي □ قريب □ طبيب □ صيدلي □أخرى		□ الأول □ الثاني □ الثالث
□ 51.10 مثبتات الحمل	□شخصي □ قريب □ طبيب □ صيدلي □أخرى		□ الأول □ الثاني □ الثالث
□ 51.11 أخرى حدد----	□شخصي □ قريب □ طبيب □ صيدلي □أخرى		□ الأول □ الثاني □ الثالث

52. هل قمت بصبغ شعرك خلال الحمل؟ □ نعم □ لا

53. إذا كانت الإجابة بنعم في أي ثلث ؟ □ الأول □ الثاني □ الثالث

54. هل تعرضت الأم للأشعة خلال فترة الحمل (غير الالتراساوند) ؟ □ نعم □ لا

55. اذا كانت الإجابة بنعم حدد ي النوع ؟ □ أشعة سينية □ صورة مقطعية □ رنين مغناطيسي □ أخرى حدد ----------

56. إذا كانت الإجابة بنعم في 54 في اي ثلث من الحمل ؟ □ الأول □ الثاني □ الثالث

57. هل تعرضت خلال فترة الحمل لأي اصابة ؟ □ نعم □ لا

58. إذا كانت الإجابة بنعم ما هو سبب الإصابة؟ □ حادث سيارة □ سقوط من علو أو على الدرج □ انفجار أو قصف □ أخرى حدد ------------

59. إذا كانت الإجابة بنعم في 57 في اي ثلث من الحمل ؟□ الأول □ الثاني □ الثالث

60. هل كان حدث قصف بالقرب منك خلال فترة الحمل ؟ □ نعم □ لا

61. إذا كانت الإجابة بنعم في 60 في اي ثلث من الحمل ؟□ الأول □ الثاني □ الثالث

62. كم كان بعد الانفجار أو القصف عنك بالأمتار؟ --------

63. هل تناولت حبوب الفوليك أسيد قبل الحمل؟ □ نعم □ لا

64. إذا كانت الإجابة بنعم ، ما هي المدة الزمنية لاستخدام الفوليك أسيد قبل الحمل بالأشهر؟-------

65. هل تناولت أي مقويات أو مكملات غذائية خلال فترة الحمل؟ □ نعم □ لا

يمكنك اختيار أكثر من إجابة

المقوي	نعم	لا	المدة الزمنية	ثلث الحمل
65.1 فوليك أسيد				□ الأول □ الثاني □ الثالث

65.2 الحديد				□ الأول □ الثاني □ الثالث
65.3 اوميغا 3(زيت السمك)				□ الأول □ الثاني □ الثالث
65.4 فيتامينات				□ الأول □ الثاني □ الثالث
65.5 كالسيوم				□ الأول □ الثاني □ الثالث
65.6 أخرى حدد -----				□ الأول □ الثاني □ الثالث

العوامل المتعلقة بصحة وأمراض الطفل

.66 ما هو نوع الولادة ؟ □ طبيعي □ طبيعي بمساعدة الشفط □ طبيعي بمساعدة الملقط □ قيصري	
.67 هل كان هناك أي مضاعفات خلال الولادة؟ □ نعم □ لا	
.68 إذا كانت الإجابة بنعم في 67 حدد □ ولادة متعسرة □ نزيف □تعب الجنين □ أخرى حدد-------	
.69 عمر المولود بالأسابيع -------------	.70 مولود توأم أو أكثر□ نعم □ لا
.71 هل الطفل □ خدج □ مولود على الموعد □ متأخر عن الموعد	
.72 وزن الطفل عند الولادة بالجرام؟ -----------	
.73 هل أدخل المولود للحضانة؟ □ نعم □ لا (إذا كانت الإجابة بلا انتقل إلى السؤال 78)	
.74 ما هي المدة الزمنية التي قضاها الطفل بالأيام؟-----------------------	
.75 ما هو السبب؟ يمكن اختيار أكثر من يمكن اختيار أكثر من إجابة □ التهاب شديد □ ولادة مبكرة □ صعوبة في التنفس	□ نقص أكسجين عند الولادة □ وزن مولود أقل من 2500 جرام □ أمراض كلية □ أخرى حدد-------- □ لا أعلم
.76 هل احتاج الطفل لتنفس اصطناعي؟ □ نعم □ لا	.77 إذا كانت الإجابة بنعم في 76 ما هي المدة الزمنية للتنفس الاصطناعي بالأيام؟ ----------------
.78 هل عانى الطفل من اصفرار خلال الشهر الأول من عمره ؟ □ نعم □ لا (إذا كانت الإجابة بلا انتقل إلى السؤال 82)	
.79 إذا كانت الإجابة بنعم ما هي المدة الزمنية للاصفرار بالأسابيع ؟-------------	
.80 ما هو سبب الاصفرار؟	□ فسيولوجي □ صفار حليب الأم □ عدم توافق زمرة دم الأم و الطفل □ التهابات □ اصابة في الرأس □ أخرى حدد------ □ لا أعلم
.81 كيف تم علاج الاصفرار؟ □ مراقبة و متابعة فقط □ بالضوء □ تغيير دم المولود □ أخرى حدد-------	
.82 هل شخص الطفل بوجود أي تشوهات خلقية؟ □ نعم □ لا	

.83 إذا كانت الإجابة نعم في 82 حدد (يمكن اختيار أكثر من إجابة) □ الوجه □ الأذن □ الجمجمة	□ الجهاز العصبي □ الجهاز الهضمي □ الجهاز البولي □ القلب	□ الأطراف العليا □ الأطراف السفلي □ أخرى حدد

.84 هل عانى الطفل خلال الفترة السابقة لمرض شديد ؟ □ نعم □ لا	.85 إذا كانت الإجابة بنعم حدد □ حمى شوكية □ التهاب أغشية الدماغ □ التهاب في الصدر (الرئتين)

	□ التهاب متكرر في الأذن الوسطى □ التهاب متكرر في البول □ النكاف
86. هل احتاج الطفل لدخول المستشفى ؟ □ نعم □ لا	
87.هل تعرض الطفل لإصابة شديدة خلال الفترة السابقة؟ □ نعم □ لا	
88. إذا كانت الإجابة بنعم حدد □ سقوط من علو □ حادث طرق □ انفجار، قصف □ أخرى حدد	
89. هل أخذ الطفل أدوية تؤثر أو تضر بالسمع خلال الفترة السابقة ؟ □ نعم □ لا □ لا أعلم	
90. هل تعرض الطفل لأي تصوير تشخيصي خلال الفترة السابقة ؟ □ نعم □ لا (إذا كانت الإجابة بلا انتقل إلى السؤال 93)	
91. إذا كانت الإجابة بنعم حدد (يمكنك اختيار أكثر من خيار) □ التراساوند □ صورة سينية □ صورة مقطعية □ صورة رنين مغناطيسي	
92. كم مرة تعرض الطفل للتصوير؟ -----	
93. هل تم استخدام المضادات الحيوية خلال الفترة السابقة من عمر الطفل؟ □ نعم □ لا □	
94.إذا كانت الإجابة بنعم كم مرة تم استخدام المضادات؟ --------	
95. ما هو اسم المضاد؟ (يمكن اختيار أكثر من إجابة) □ موكسيبن □أوجمين □كفلكس□ زينات□ اديسيف□ سيتروسين أو ازيميك □ سالبريم □ جنتاميسن □ روسيفين □ أخرى حدد	
96. إذا كان عمر الطفل الآن أقل من 6 أشهر ما هو نوع الرضاعة: □ رضاعة طبيعية □ حليب صناعي □ خليط من الأثنين	97. إذا كان عمر الطفل الآن أكثر من 6 أشهر، ما نوع الرضاعة خلال الستة أشهر الأولى؟ □ رضاعة طبيعية □ حليب صناعي □ خليط من الأثنين
الخدمات الصحية المقدمة	
98. هل كان هذا الحمل مخطط له ؟ □ نعم □ لا	
99. هل تلقيت خدمة رعاية ما قبل الحمل؟ □ نعم □ لا	100.إذا كانت الإجابة بنعم، أين تلقيت الخدمة؟ □ وكالة الغوث □ وزارة الصحة □ مراكز خاصة □أخرى حدد---------
101. هل تلقيت خدمة رعاية متابعة الحمل؟ □ نعم □ لا (إذا كانت الإجابة بلا انتقل للسؤال رقم 106)	102.إذا كانت الإجابة بنعم، أين تلقيت الخدمة؟ □ وكالة الغوث □ وزارة الصحة □ مراكز خاصة □أخرى حدد---------
103. إذا كانت الإجابة بنعم في أي ثلث تم التسجيل في مراكز الرعاية؟ □ الأول □ الثاني □ الثالث	
104. عدد زيارات متابعة الحمل ؟-------------	
105. خلال زيارات متابعة الحمل هل تم عمل التالي ؟	

	نعم	لا	لا أتذكر
105.1 قياس الضغط			
105.2 فحص البول			
105.3 فحص الدم			
105.4 قياس الطول			
105.5 تصوير التراساوند			
105.6 فحص الثدي			
105.7 متابعة نبض الجنين			
105.8 فحص اكلينيكي كامل			

<table>
<tr><td colspan="2">106. هل خضعتي لتصوير التراساوند خلال الحمل؟ □ نعم □ لا</td></tr>
<tr><td colspan="2">107. إذا كانت الإجابة بنعم كم مرة؟--------</td></tr>
<tr><td colspan="2">108. ماذا كانت نتيجة الالتراساوند ؟ □ طبيعي □ غير طبيعي</td></tr>
<tr><td colspan="2">109. إذا كانت النتيجة غير طبيعية ، حدد ---</td></tr>
<tr><td colspan="2">110. أين كانت الولادة؟ □ مستشفى حكومي □ مستشفى خاص □ عيادة خاصة □المنزل □أخرى حدد ------</td></tr>
<tr><td colspan="2">111. كيف تصفين الخدمة خلال عملية الولادة؟
□ سيئة جدا □ سيئة □ معقولة □ جيدة □ ممتازة</td></tr>
<tr><td>112. هل تلقيت خدمة ما بعد الولادة ؟
□ نعم □ لا (إذا كانت الإجابة بلا انتقل للسؤال رقم 116)</td><td>113. إذا كانت الإجابة بنعم خلال
□ الأسبوع الأول □ الأسبوع الثاني- الثالث □ الأسبوع الرابع</td></tr>
<tr><td>114. كم عدد الزيارات؟ ----------</td><td>115. أين تلقيت الخدمة؟
□ وكالة الغوث □ وزارة الصحة □ مراكز خاصة □أخرى حدد---------</td></tr>
<tr><td colspan="2">116. هل تم فحص الطفل خلال التطعيم الأول أو خلال رعاية ما بعد الولادة؟ □ نعم □ لا</td></tr>
<tr><td colspan="2">117. إذا كانت الإجابة بنعم ما ذا كان تعليق الطبيب؟
□ لا تعليق
□ طبيعي
□ غير طبيعي حدد---------</td></tr>
<tr><td>118. هل حصل الطفل على كل التطعيمات ؟
□ نعم □ لا</td><td>119. إذا كانت الإجابة بلا وضحي الأسباب؟
□ مرض مفاجئ □ مرض مزمن □ ردة فعل للتطعيم □ صعوبة في الوصول</td></tr>
<tr><td colspan="2">120. هل هناك أي عوائق للوصول للخدمات الصحية المختلفة ؟ □ نعم □ لا</td></tr>
<tr><td colspan="2">121. إذا كانت الإجابة بنعم ما هي نوع العوائق ؟ (يمكن اختيار أكثر من إجابة)
□ حركي □ اجتماعي □ مادي □ نقص الكفاءات □ أخرى حدد</td></tr>
<tr><td colspan="2">الظروف البيئية</td></tr>
<tr><td colspan="2">122.هل يتعرض الطفل لصوت عالي بشكل مستمر؟ □ نعم □ لا</td></tr>
<tr><td colspan="2">123. إذا كانت الإجابة بنعم حدد
□ مصنع قريب □ موسيقى □ شبكة مواصلات □ مولدات □ أخرى حدد----</td></tr>
<tr><td colspan="2">124. هل تعرض الطفل لصوت عالي جدا و لو لمرة واحدة؟ □ نعم □ لا</td></tr>
<tr><td colspan="2">125. إذا كانت الإجابة بنعم حدد
□ انفجار قريب □ قنابل صوتية □ أخرى حدد--------</td></tr>
<tr><td colspan="2">126. إذا كان الطفل قد تعرض لصوت عالي نتيجة انفجار ، كم كانت المسافة؟-------</td></tr>
<tr><td colspan="2">127. هل تعرض الطفل للتدخين ؟ □ نعم □ لا</td></tr>
<tr><td colspan="2">128. إذا كانت الإجابة نعم حدد □ وهو جنين □ بعد الولادة □ في الحالتين</td></tr>
<tr><td>129. هل الأم مدخنة؟
□ نعم غالبا سجائر
□ نعم غالبا شيشة
□ نعم سجائر و شيشة
□ مدخنة سابقة و توقفت عن التدخين
□ غير مدخنة</td><td>130.هل الأب مدخن؟
□ نعم غالبا سجائر
□ نعم غالبا شيشة
□ نعم سجائر و شيشة
□ مدخن سابقة و توقف عن التدخين
□ غير مدخن</td></tr>
<tr><td colspan="2">131. هل يوجد مصنع بالقرب من المنزل؟ □ نعم □ لا</td></tr>
<tr><td colspan="2">132. إذا كانت الإجابة بنعم ما هو نوع المصنع؟
□ مواد غذائية □ منظفات □ بطاريات □ مواد كيميائية □ أخرى حدد ----------</td></tr>
<tr><td colspan="2">133. هل يتعرض أفراد الأسرة بصورة متكررة لمواد او أبخرة كيميائية كالمبيدات أو المنظفات ؟
□ نعم □ لا</td></tr>
<tr><td colspan="2">134. إذا كانت الإجابة بنعم حدد □ مبيدات حشرية □ مبيدات زراعية □ منظفات</td></tr>
</table>

135. هل البيت جيد التهوية ؟ □ نعم □ لا
136. هل تدخل أشعة الشمس المنزل بصورة جيدة؟ □ نعم □ لا
137. هل هناك اسبستس في المنزل؟ □ نعم □ لا
138. متى تم طلاء المنزل آخر مرة؟ -------
139. هل هناك تجمع مجاري قريبة؟ □ نعم □ لا
140. إذا كانت الإجابة بنعم، كم المسافة؟ ----------
141. هل هناك مكب نفايات قريب ؟ □ نعم □ لا
142. إذا كانت الإجابة بنعم، كم المسافة؟ ----------
143. هل هناك محطة بترول (بنزينة) قريبة؟ □ نعم □ لا
144. إذا كانت الإجابة بنعم، كم المسافة؟ ----------

Annex 6: Helsinki approval

المجلس الفلسطيني للبحث الصحي

Palestinian Health Research Council

تعزيز النظام الصحي الفلسطيني من خلال مأسسة استخدام المعلومات البحثية في صنع القرار

Developing the Palestinian health system through institutionalizing the use of information in decision making

Helsinki Committee

For Ethical Approval

Date: 2017/08/07 **Number:** PHRC/HC/233/17

Name: RANDA F. ZAQQOUT الاسم:

We would like to inform you that the committee had discussed the proposal of your study about:

نفيدكم علماً بأن اللجنة قد ناقشت مقترح دراستكم حول:

Risk Factors of Hearing Impairment Among Infants in the Gaza Strip: A Case Control Study

The committee has decided to approve the above mentioned research. Approval number PHRC/HC/233/17 in its meeting on 2017/08/07

و قد قررت الموافقة على البحث المذكور عاليه بالرقم والتاريخ المذكوران عاليه

Signature

Member **Member**

Chairman

7/8/2017

Genral Conditions:-

1. Valid for 2 years from the date of approval.
2. It is necessary to notify the committee of any change in the approved study protocol.
3. The committee appreciates receiving a copy of your final research when completed.

Specific Conditions:-

E-Mail:pal.phrc@gmail.com

Gaza - Palestine غزة - فلسطين

شارع النصر - مفترق العيون

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Annex 7: Experts and professional consulted:

The study tool (interviewed questionnaire) was reviewed and evaluated by the following experts:

- Dr. Bassam Abu Hamad, Al Quds University
- Dr. Yehia Abed, Al Quds University
- Dr. khitam Abu Hamad, Al Quds University
- Dr.Majed Awadella Pediatrics specialist
- Dr.Sawsan Shurab Pediatrics specialist
- Dr.Hiyam Saqqalah Pediatrics specialist
- Dr.Isa Mussalem ENT specialist
- Dr.Jaber Abu Amr ENT specialist
- Mr.Ramadan Hussein Audiologist