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Universal newborn hearing screening in Kuwait (UNHS) National Program

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Abstract

Hearing loss is one of most important disorders to be identified and managed as early as possible, especially in newborns infants and children group, in order to prevent the serious complications that can follow it. The prevalence of hearing loss is increasing all over the world every year. It is known that, the prevalence is 1-3 in 1000 born children for severe to profound hearing loss, while if we considered the other degrees (mild and moderate), then the percentage will increase, may be ten folds. In Kuwait our National universal hearing screening in newborns started in 2013 and is going on. Data collected over around 10 years. The first screening is done before discharging the mother with her baby from the hospital. Failed first screening had been scheduled for second screening at the age of one month. Failed the second screening were immediately scheduled for diagnostic assessment including all objective tests. Taking into consideration, that all at risk of hearing loss babies on first screening even if passed, the newborns were scheduled for long follow up in sheikh Salem Al Ali Center for hearing and speech in Kuwait. First screening results showed total birth 105,657, out of which NHS 81976 (77.6%). Passed cases were 72,305 (88.2%), while failed cases 9671 (11.8%) and missed in 23681 (28.9%). Total male showed 42054 (51.3%), while females showed 39922 (48.7%). Kuwaiti nationality showed total of 22060 (26.9%), while higher number of non- Kuwaiti nationality detected 59916 (73.1%). The second screening results showed, 4284 (44.3%) passed, while the failed test was 5387 (55.7%). Out of the referred cases of the second screening, Conductive hearing loss found to be 1369 (14.2%), 280 (2.9%) showed to have SNHL,12 (0.12) diagnosed as congenital ear anomalies (external and/ or middle ear problems), cases not shown up were 3726 (38.5%).

Keywords: Hearing screening, newborns, AABR & TEOAE, SNHL, CHL, ear congenital anomalies.

الملخص العربي

يعتبر ضعف السمع من المشاكل الصحية الهامة التي يجب اكتشافها سريعا يتبعها تدخل علاجي سريع في وقت مبكر لدي الأطفال، وذلك لتدارك ومنع المضاعفات التي قد تترتب عليها. نسبة ضعف السمع في تزايد مستمر بالعالم أجمع سنويا، حيث أنه عالميا النسبة تتراوح من 1الي 3 حالات لكل 1000 طفل يولد يعاني من ضعف سمعي شديد إلي شديد جدا، أما لو تم إدراج الدرجات الأقل فالنسبة تتضاعف إلى ما يقارب عشر أضعاف. تم بدء البرنامج الوطني للمسح السمعي الشامل بالكويت سنة 2013 وهي مستمرة. تم جمع البيانات خلال فترة العشر سنوات، حيث أن المسح السمعي الأول اجري بعد ولادة الطفل وقبل خروجه من المستشفى. الحالات التي كانت نتائجها سلبية تم إعطاءها موعد عند عمر الشهر لعمل المسح السمعي الثاني في قسم السمع التابع للمنطقة. عند تبين سلبية النتائج مع المسح السمعي الثاني تم جدولتها للفحوصات السمعية التشخيصية بحيث يكون الطفل كامل التشخيص عند عمر الثلاث شهور وكامل التدخل علاجيا (دوائي أو مساعدات سمعية أو زراعة قوقعة) عند عمر الستة أشهر. وفيما يخص النتائج للمسح السمعي الأولي فقد كان عدد حالات الولادة 105657 وتم مسح 81976 حالة، منها 72305 عدد حالات النتائج الإيجابية والحالات السلبية 9671, أما الحالات التي تم فقد أخذ المسح السمعي لها 23681. مع إجراء المسح الثاني كانت عدد النتائج الإيجابية 4284، عدد الحالات السلبية كانت 5387 واختلفت النتائج ما بين ضعف السمع التوصيلي (1369) 14.1%، ضعف السمع الحسي العصبي 280 (2.9%)، العيوب الخلقية للأذن الخارجية والوسطي 0.12% والتي لم يتم الفحص السمعي لها 3726 (38.5 %). وقد كانت نسبة الذكور مقارنة بالإناث ليست ذات الفرق الملحوظ بينما نسبة الكويتيين مقارنة بغير الكويتيين الفارق كبير وملحوظ وذلك بسبب نسبة الغير كويتيين المتواجدين داخل الكويت أكبر من الكويتيين. ومن خلال نتائج البحث تبين أن المسح السمعي الشامل من البروتوكولات الضرورية والهامة للدولة للاكتشاف المبكر لضعاف السمع والتدخل العلاجي السريع. نسبة ضعف السمع تقريبا تتماشى مع النسب العالمية الا أنه لوحظ أنه بسبب عدم التزام عدد كبير من الأهالي لعمل المسح الثاني كان له أثر كبير على النسبة الأقل المتبينة بالنتائج. هذا فيما يخص ضعف السمع الحسي العصبي أما فيما يخص نتائج التهابات الأذن الوسطى فهي نتائج عالية علما بأن المراجعات لها أثر كبير في علاج هذه الحالات وعودة الأذن الى طبيعتها وعودة السمع الى الحدود الطبيعية. أما فيما يخص العيوب الخلقية فنتائجها مقبولة0.12 ولم تختلف كثيرا عن النسب العالمية. وفي نهاية البحث يتبين أن هناك بعض المتطلبات الهامة منها: استمرار المسح السمعي الشامل، تدارك نقص المستهلكات للأجهزة، وجود نظام تتبع للحالات حتى نتفادى تخلف أي حالة، لإضافة إلي وجود عدد كافي من الطاقم الطبي للمسح.

Introduction

Hearing loss is one of most important disorders to be identified and managed as early as possible, especially in children group, in order to prevent the serious complications that can follow it. The prevalence of hearing loss is increasing all over the world every year. It is known that, the prevalence is 3-1 in 1000 born children for severe to profound hearing loss, while if we considered the other degrees, then the percentage increases, may be ten folds. The mission of the Joint Committee on Infant Hearing (JCIH) is to address issues that are important to the early identification, intervention, and follow-up care of infants and young children with hearing loss.

Katarzna et al. (2017) reported that, the incidence of sensorineural hearing loss ranges from 1 to 3 per 1,000 live births in term of healthy neonates, and 2-4 per 100 in high - risk infants, a 10–fold increase. Early identification and intervention with hearing augmentation within 6 months yields optimal effect. If undetected and without treatment, significant hearing impairment may negatively impact speech development and lead to psychological and mental behaviours. Hearing screening programs in newborns enable detection of hearing impairment in the first days after birth. Programs to identify hearing deficit have significantly improved over the two decades, and their implementation continues to grow throughout the world. More than 80% of permanent hearing losses (HL) in children are congenital. Newborn hearing screening (NHS) is the best method for early detection of suspected hearing loss. If the NHS is not universal, more than 30% permanent hearing losses are not identified. There are various methods of NHS: otoacoustic emissions (TEOAE, DPOAE) and automatic auditory brainstem response (AABR) (Janka Jakubikova et al., 2009). UNHS programs detect permanent bilateral hearing loss (PBHL), permanent conductive or sensorineural hearing loss of 40dB or greater in the better ear and unilateral loss. The prevalence of severe or profound PBHL (>60dB) loss in newborns is 1 to 1.5 per 1000 live birth (Karen Edmond, et al., 2022). An additional 1 to 2 per 1000 newborns have bilateral mild to moderate hearing loss of any degree. Both severe and profound PBHL result in major impairment in language and literacy development, functioning in adulthood and quality of life. Causes of PBHL include intrauterine infections such as TORCH infections (Toxoplasmosis, rubella, cytomegalovirus, herpes simplex, syphilis), genetic abnormalities, and craniofacial problems. Approximately, 50% of newborns with PBHL have an identifiable risk factor (Karen Edmond et al., 2022).

Aim & Objectives

The aim of our study was to do universal newborn hearing screening, using both AABR and TEOAE, in order to find out infants who have hearing loss as early as possible, in order that the newborn is diagnosed and started intervention fully by age of three months and full management is done by age of 6 months.

Related Works

Hearing loss is a prevalent condition in children that frequently manifests in infancy due to congenital, intrauterine, perinatal, and postnatal factors (Wroblewska-Seniuk, et al., 2017; Grindle, C.R., 2014). The extent of hearing impairment varies, with international data indicating a prevalence of severe hearing loss between 1 and 3 per 1,000 in well-baby nurseries and 2 to 4 per 100 in infants within the intensive care unit (Yoon, et al., 2003). Delays in hearing assessments are widely acknowledged to have detrimental consequences for developing children, frequently resulting in delays in speech acquisition, literacy, and social competencies (Johnson, C.E., 2018).

Historically, these patients were identified well after the neonatal period, and delays in diagnosis until the child attained school age were not uncommon. Evidence indicates that children diagnosed with hearing loss within the initial six months of life are more likely to achieve superior language development. Universal newborn hearing screening (UNHS) has emerged as a standard practice in numerous countries globally, effectively identifying at-risk children and facilitating appropriate intervention. These programs generally utilize a dual strategy: pre-discharge screening from the hospital and subsequent testing for children who do not pass in-hospital screening (Patel, et al., 2011).

Infants with enduring hearing impairments will necessitate comprehensive assessment and management by a proficient team comprising pediatricians, audiologists, otolaryngologists, speech-language pathologists, and early intervention specialists. UNHS protocols differ by country, especially regarding the timing of the initial screening and the specific testing methods employed (e.g., otoacoustic emissions and auditory brainstem response) (Wroblewska-Seniuk, et al., 2017; Joint Committee on Infant Hearing, 2007). The Joint Committee on Infant Hearing (JCIH) has advised that nations formulate their programs according to administrative backing, financial allocations, and available resources (Grey, et al., 2022).

Subject and Methods

Our universal newborn hearing screening started on 2013 and is going on. The different government hospitals, which has maternity and neonatology departments, has been involved (Sabah maternity, Sabah neonatology, Farwaniya, Jahra, Adan and Jaber Al Ahmad hospital). On daily basis, our audiologists are going to the different departments, each hospital with their audiologist. Newborns are being screened nearby their discharge from the hospital usually not less than the second day minimum, in order to avoid artifacts as much as possible, especially for TEOAE results.

The screening is done by using AABR and OAE device, AccuScreen (MADSEN). The test is done in quite area as much as possible to avoid noise, away from electrical wires and radiology which can affect the results.

The first screening, results mentioned as either pass or fail and the special form are filled and signed by both, the mother and the audiologist is doing the test.

Pass cases have been sent home, while failed cases, were given an appointment in the audiology department in the same hospital for a second screening using same device at one month of age. After the second screening, if the test results pass, the infant has been sent home, while failed test result cases, assigned for diagnostic tests using tympanogram, ABR, TEOAE, and some of them go through ASSR, to confirm if there is hearing loss and find out which types and degree, in order to start immediate intervention. Taking into consideration that, newborns who have risk factors for hearing loss will be closely under eyes in audiology clinics to ensure well- being or to early detect hearing losses if they have it.

Risk factors that should be careful to continue following up with, such as: Preterm <37 weeks gestation age, low birth weight <1500gm, +ve family history of hearing loss, congenital and syndromic features of the newborn, high bilirubinemia up to the need to exchange of blood, TORCH infection,).

Inclusion Criteria

1/ All newborns to be first screened nearby discharge from the hospital after birth, preferred not before the second day after delivery.

2/ 2nd screening for the first failed screening results at 4 weeks of age.

3/ Both genders (males and females) are involved.

4/ All nationalities are being involves in the screening (Kuwaitis and non-Kuwaitis).

5/ All governmental hospitals having maternity and neonatology departments are involved.

Exclusion Criteria

Actually, there is no exclusion criteria for the universal newborn hearing screening. But the severely at-risk factors newborns were postponed first screening according to their medical general condition and if were impossible to run the test.

Results

Data from 2013 up to December 2023 around 10 years has been collected, first screened data were collected as pass\ fail results, as well as the second screening results. The failed cases of the second screening were immediately taken to diagnostic procedures (Tympanogram, Diagnostic ABR, TEOAE, ASSR), after, which, reported the number of normal, conductive and sensorineural hearing loss cases.

Total birth number in 2013-2014, was 11855, the newborn hearing screening (NHS) done on 8130 (68.6%), the first screening showed 7876 (96.8%) pass cases, while 254 (3.1%) failed the screening. The second screening done for failed cases after one month post discharge, the number of normal cases was 83, failed second screening 169. Out of the169 refer cases 40(23.6%) showed conductive hearing loss (CHL), 25 (14.8%) showed sensorineural hearing loss (SNHL) and 104 not shown up. In 2015, total birth was 11760, screened 9229 (78.5%). The first screening showed 8456 (91.6%) pass cases, 773 (8.4%) failed the screening. The second screening, showed 461 passed cases, 311 refer cases. Out of the 311 refer cases, 48 (15.4 %) had CHL, 31 (10%) had SNHL, 232 not shown for the test 74.5%.

On 2016, total birth was done 11938, NHS on 9893 (82.8%). The passed cases on the first screening were 8694 (87.9%), while 1199 (12.1%) failed the screening. The second screening out of 1199 cases, showed 489 normal results, 710 refer, out of the 281, 245 (34.5%) had CHL, 37 (5.2%) had SNHL, 428 not shown (60.3%).

On 2017, total birth was 12363, NHS done on 10268 (83.05%). The results of first screening showed 9051 (88.1 %) pass, 1217 (11.9 %) failed results. The second

screened of 1217 case, showed 583 normal results, 633 refer, out of the 633 referred cases, 148 (23.4%) had CHL, 40 (6.3 %) SNHL.

On 2018, total birth was 11167, NHS 9403 (84.2%). Pass results on the first screening were 8407 (89.4%), fail of 996 (10.6%). On the second screening 996, 450 passed the test, 546 refer, out of the 546, 97 (17.8%) had CHL and 35 (6.4 %) had SNHL, 414 not shown up 75.8%.

On 2019, total birth was 10738, NHS 9397 (87.5%). The first screening showed 8164 (86.8%) pass, 1233 (13%) failed results. On the second screening 1233, around 499 cases pass, 732 refer, 578 (78.9 %) not shown for the test. Out of the 732 referred cases, 117 (15.2%) had CHL, 37 (5.05 %) showed SNHL.

On 2020, total birth was 9506, NHS 4410 (46.2%). The first screening showed 4028 (91.3%), 382 (8.7%) fail results. On the second screening 382 case, 159 normal results, 223 refer, 123 (55.1%) not shown. Out of the 223 refer cases, 88 (39.5%) CHL, 12 (5.4%) SNHL.

On 2021, total birth was 8463, NHS 4846 (57.3%). On first screening 4384 (90.5%) pass, fail of 462 (9.5%). On the second screening 462 case, 225 passed, 234 refer, 148 (32%) not shown. Out of 234 refer, 69 (29.5%) CHL, 17 (7.3 %) SNHL.

On 2022, total birth 7902, NHS on 7142 (90%). On first screening, 5832 (81.6%) pass the test, while 1310 (18.3%) failed. On the second screening, 599 passed, 709 refer, 582 (44.4%) not shown. Out of the 709 refer cases, 100 (14.1%) had CHL, 27 (2.4 %) SNHL.

On 2023, total birth was 9965, NHS done on 9258 (92.9%). On the first screening, 7413 (80.07%) passed the test, 1845 (19.9%) failed the test. On the second screening, 736 passed, 1108 refer, 672 (60.6%) not shown. Out of the 1108 refer cases, CHL was 417 (37.6%), 19 (0.3%) SNHL.

So, total birth over around 10 years showed 105657, NHS done on 81976 (77.6%). On the first screening 72305 (88.2%) passed the test, while 9671 (11.8 %) failed the test. On the second screening, 4284 passed the test, 5375 refer, 3726 (38.5%) not shown. Out of the 5375 refer cases, 1369 (25.5%) had CHL and 280 (2.9%) showed SNHL.

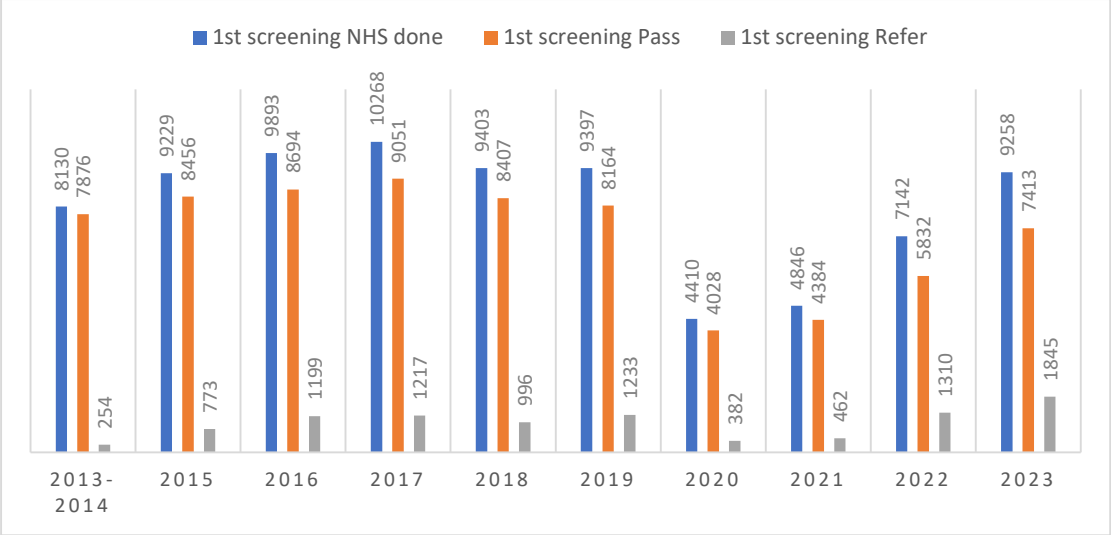


Figure (1) First universal hearing screening results

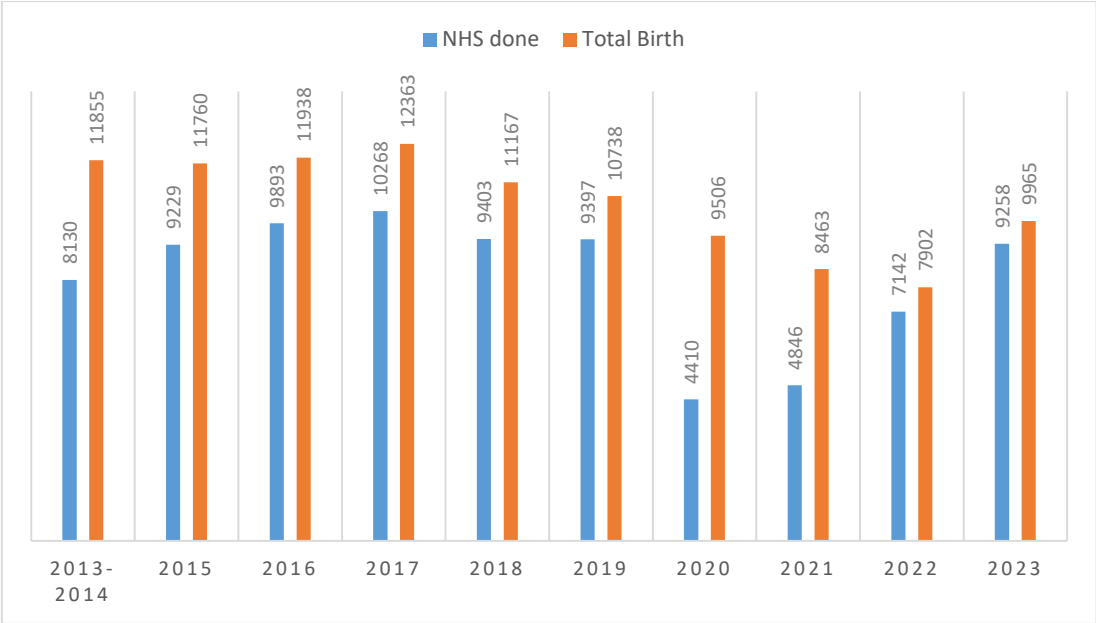


Figure (2) First Universal Hearing Screened newborns out of total birth

Table (1): First screening Results

Year	Total birth	NHS	Pass	Fail	Missed cases	Male	Female
2013/ 2014	11855	8130 (68.6%)	7876 (96.8%)	254 (3.1%)	3725	3736	4394
2015	11760	9229 (78.5%)	8456 (91.6%)	773 (8.4%)	2531	4764	4465
2016	11938	9893 (82.8%)	8694 (90.6%)	1199	2045	5061	4832
2017	12363	10268 (83.05%)	9051 (88.1%)	1217 (11.8%)	2095	5278	4990
2018	11167	9403 (84.2%)	8407 (89.4%)	996 (10.6)	1764	4815	4588
2019	10738	9397 (87.5%)	8164 (86.8%)	1233 (13%)	1341	4907	4490
2020	9506	4410 (46.2%)	4028 (91.3%)	382 (8.66%)	5096	2347	2063
2021	8463	4846 (57.3%)	4384 (90.5%)	462 (9.5%)	3617	2545	2301
2022	7902	7142 (90%)	5832 (81.6%)	1310 (18.3%)	760	3769	3373
2023	9965	9258 (89.4%)	7413 (88%)	1845 (12%)	707	4832	4426
Total	**105657**	**81976 (96.8%)**	**72305 (88.9%)**	**9671 (11%)**	**23681 (28.1%)**	**42054 (51.3%)**	**39922 (48.7%)**

Table (2): 2nd Screening results

Year	Refer	Normal	Hearing loss			
			Conductive	SNHL	Congenital	Not Turned Out
2013-2014	254	83	40	25	2	104
2015	773	461	48	31	1	232
2016	1199	489	245	37	0	428
2017	1217	583	148	40	1	445
2018	996	450	97	35	0	414
2019	1233	499	117	37	2	578
2020	382	159	88	12	0	123
2021	462	225	69	17	3	148
2022	1310	599	100	27	2	582
2023	1845	736	417	19	1	672
TOTAL	9671	4284	1369 (14.2%)	280 (2.9%)	12	3726 (38.5%)

As regard nationalities underwent universal hearing screening, the total number underwent the first screening was 105657, out of which, Kuwaitis showed around 22,060 (26.9%), while non-Kuwaitis showed 59,916 (37.1%), out of the total screened babies (81976) (Table 3).

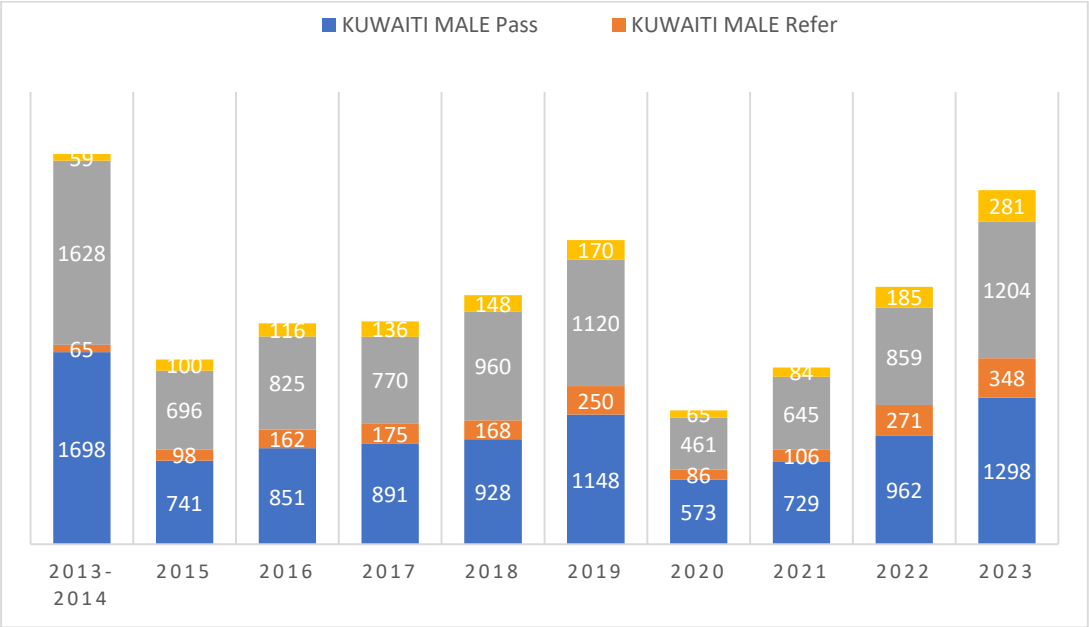


Figure (3): Results of first screened Kuwaiti newborns

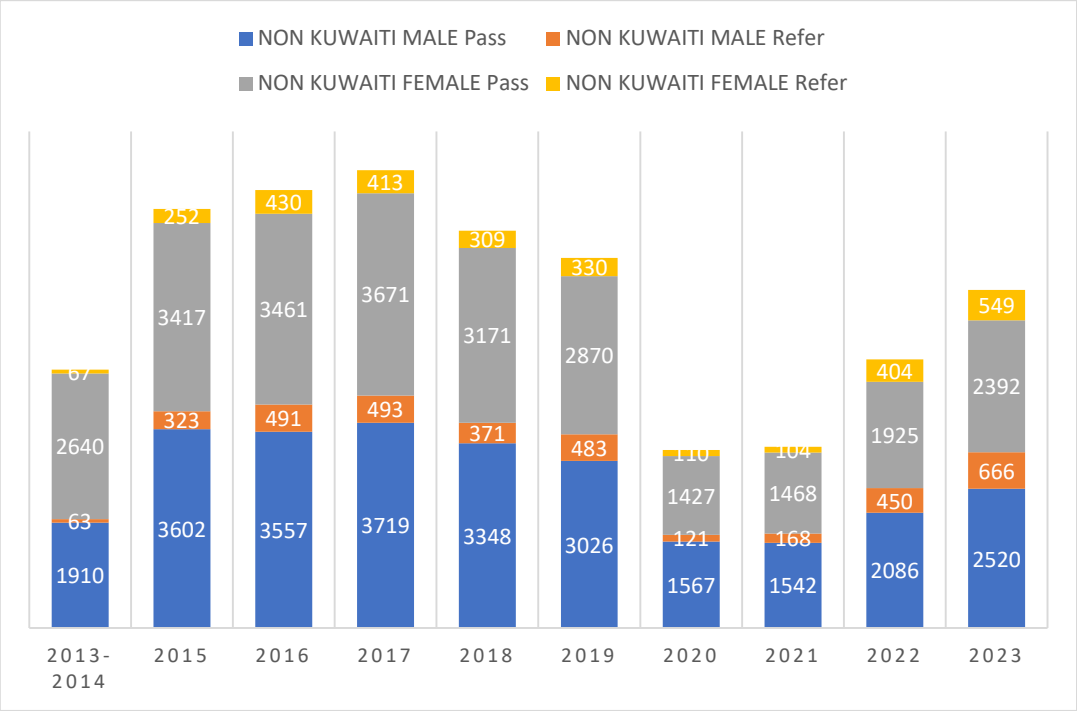


Figure (4): Results of non-Kuwaiti first hearing screened

Table (3): Kuwaiti vs non-Kuwaiti results of first screening

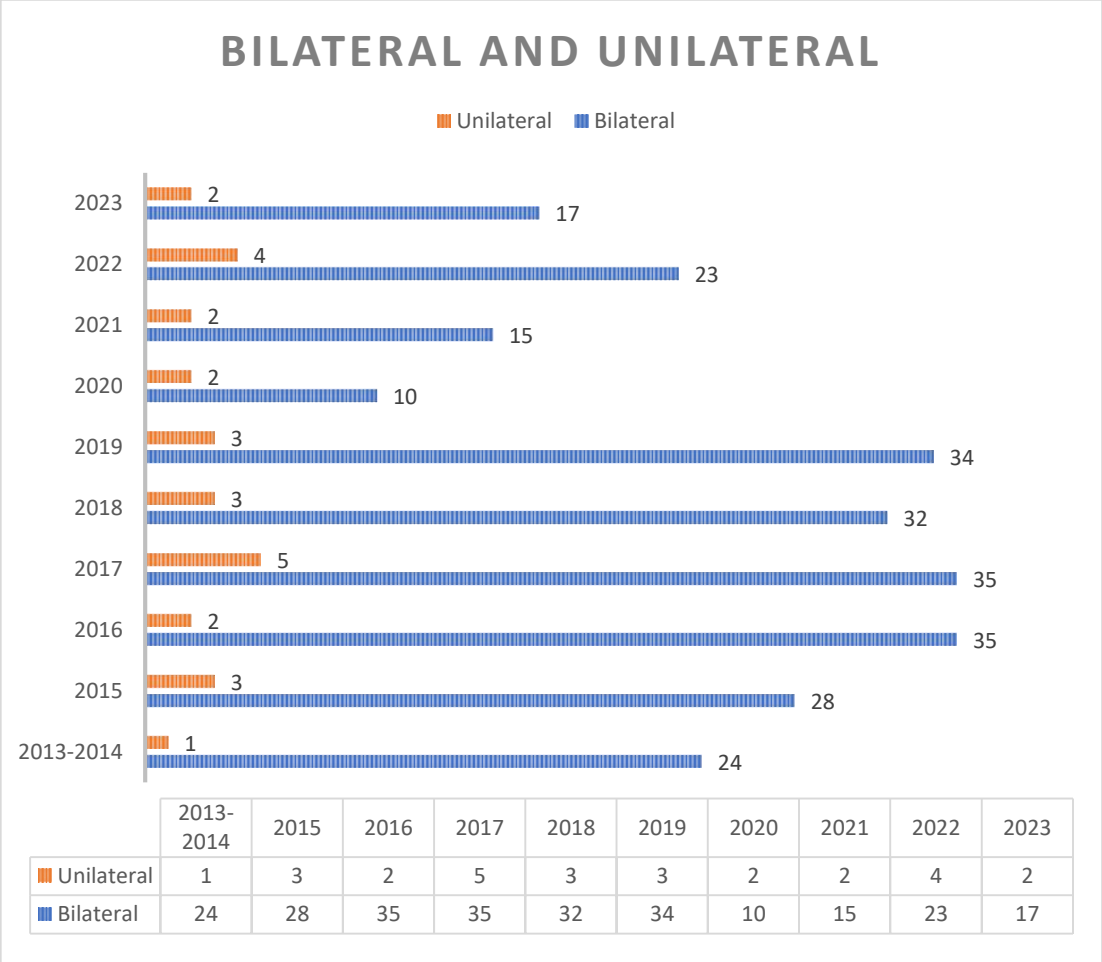
Years	Kuwaiti				Non-Kuwaiti			
	Male		Female		Male		Female	
	Pass	Refer	Pass	Refer	Pass	Refer	Pass	Refer
2013-2014	1698	65	1628	59	1910	63	2640	67
2015	741	98	696	100	3602	323	3417	252
2016	851	162	825	116	3557	491	3461	430
2017	891	175	770	136	3719	493	3671	413
2018	928	168	960	148	3348	371	3171	309
2019	1148	250	1120	170	3026	483	2870	330
2020	573	86	461	65	1567	121	1427	110
2021	729	106	645	84	1542	168	1468	104
2022	962	271	859	185	2086	450	1925	404
2023	1298	348	1204	281	2520	666	2392	549
	9819	1729	9168	1344	26877	3629	26442	2968
Total	11548		10512		30506		29410	
Total K vs NK	**22060**				**59916**			

Total Kuwaiti newborns were 22060 in number, out of which, males were 11,548, (52.3%), while females were 10512 (47.7%). Out of total males passed the test were 9819, (85.0%) while refer 1729. (15%), females showed 9168 pass (87.2%), while 1344

(12.8%) failed results shown. Total non-Kuwaitis newborns showed around 59,916, (56.7%), out of which 30,506 (50.9%) were males, 26877 pass, (88%) and 3629 fail (11.9%), while females showed 29410 total (49.1%), 26442 (89.9%) passed and 2968 failed (10.1%). Calculating the mean statistically, over 10 years, the results of CHL 25.43%, while SNHL 6.53%.

As regard SNHL, the total number was 280 out of which 253 (90.4%) had bilateral, while 27 (9.6%) newborns showed unilateral SNHL results (figure 5). Congenital ear anomalies (external and middle ear) showed 12 newborns over total 10 years screening (0.13%) (figure 6).

As regard the missed cases which missed on the first screening was 23681 (22.4%) out of the total 105657 which is not a low number and percentage (figure 6). The total not shown cases for the second screening after failed first screen was around 3726 (38.5%) out of the referred cases.



	2013-2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Unilateral	1	3	2	5	3	3	2	2	4	2
Bilateral	24	28	35	35	32	34	10	15	23	17

Figure (5): Bilateral hearing loss vs Unilateral loss

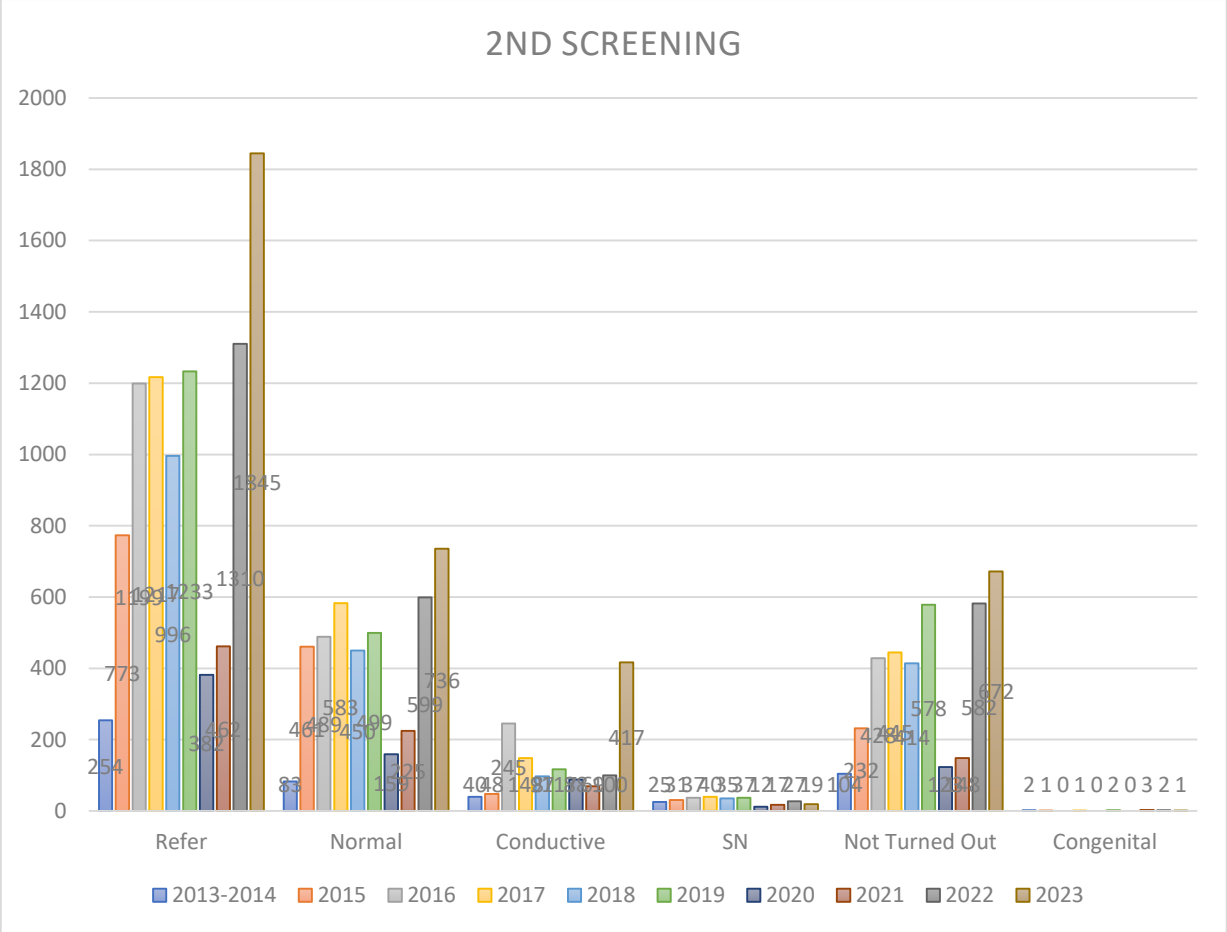


Figure (6): 2nd Newborns hearing screening results

Discussion

Universal newborn hearing screening (UNHS) has become a standard in many countries throughout the world and has been successful at identifying at-risk children and providing them with adequate intervention. These programs typically employ a two-pronged approach: screening before discharge from the hospital and follow-up testing for children that fail in-hospital screening (Yoshinaga et al., 1998, N.E. Morton 1991).

Subsequently, infants with persistent hearing deficits will then require multidisciplinary evaluation and management by a skilled team including paediatricians, audiologists, otolaryngologists, speech-language pathologists (SLP), and early intervention specialists. UNHS protocols vary by country, particularly with the timing of first screen as well as specific testing modalities (i.e., otoacoustic emission and auditory brainstem response) P.J. Yoon et al, 2003, Audiology information series). Accordingly, the Joint Committee of Infant Hearing (JCIH) has recommended that countries develop their programs based on administrative support, budget, and available resources (Kevin Choralle et al., 2021). Given the heterogeneity of clinical guidelines for newborn screening, our goal was to critically appraise existing protocols for UNHS.

Early detection and timely intervention are critical for the management of several conditions, and health professionals increasingly rely on a combination of scientific evidence, clinical judgement, and patient preference to guide this process (Kevin Coralle et al., 2021). Clinical practice guidelines offer a way to bridge these components through multidisciplinary discussion with experts and review of the best available evidence.

Universal hearing screening is so important to be done as a rule in our country, Kuwait, in order to pick up hearing loss infants as soon as possible. The rule is to match the WHO requirements and Joint Committee, which recommend 1 3 6 months of age, screened, diagnosed and started intervention and fully managed by age 6 month. Therefore, our national program started on 2013, and is ongoing. All Governmental maternity hospitals and neonatology departments have been included in the program. All newborns included (well nursery and newborn at risk) are included in the screening.

The devices used in the screening having both tests AABR and TEOAE. Audiologists are daily visiting the departments to screen the newborns nearby discharge as much as

possible, to reduce the artifacts mostly meconium. A quite area chosen to carry on the test away from noise as well as electric wires and radiology, as all these can affect the results.

Our data which had been collected for our paper work, from the start of the screening 2013 till December 2023. The total birth was 105657, out of which 81976 NHS done for them (77.3%), 72305 (88.2%) passed and 9671 (11.8 %) failed the first screening, missed cases 23681 (28.9%). Males were 42054 (51.3%), while females 39922 (48.7%).

We have around 28.9% missed the first screening, which can be mainly due to the holidays and the discharge of the mother and babies during these days, the number and percentage are not low numbers, and we are working hardly to cover this problem in order not to miss any. In addition, we have already managed with our colleagues and nurses to guide the missed cases to the audiology department in the same hospital to do the screening immediately after being discharged from the hospital.

Actually, the nationality variable showed high number of non-Kuwaitis as compared to Kuwaitis population, and this simply can be explained by lower number of Kuwaiti population compared to the non- Kuwaitis. In addition, the service is being given to all nationalities in Kuwait in the same way.

Comparing the gender difference between males and females, there was no big difference between the two, as total first screened males was 11548, while total females 10512 in number.

The second screening for the failed cases not passed the first screening before being discharged from the hospital. Out of the total failed cases over 10 years was 9671 (9.2%), out of which, 4284 passed the test (44.3%), 1381 (14.2%) showed conductive hearing loss after doing tympanogram, which in turn showed type B, while 280 (2.9%) showed SNHL, 3726 did not show for the second screening (38.5%), which is a very high number and percentage.

The percentage of CHL is not surprising as the otitis media and secretory otitis media are the common causes of hearing disorders in children. The percentage of SNHL 2.9% is surprising because our previous paper work results showed higher number, but this we can explain it as a result of high number of newborns not shown for the second

screening 38.5%. As well, we have shortage of Data tracking system which can help us in following our failure cases easily, in order not to miss any failed case. Moreover, missing cases also a significant number of newborns who, were born in private hospitals.

The device used to do the screening test, both AABR and TEOAE, showed to be very sensitive in picking up the cases, which should be used also in our private hospitals.

In Slovakia NHS started in 1998 and was provided in ENT departments. From May 1, 2006 UNHS has been mandatory in Slovakia, using two stages TEOAE in all newborn departments in Slovakia (64 newborn departments). In year 2005--42% of newborns in Slovakia were screened, in 2006--66% newborns and in 2007--94, 99% (three small newborn departments do not yet have equipment for OAE screening).

For determination of hearing thresholds ASSR are used in two ENT departments and ABR in the other four ENT departments. Results: Comparing the number of identified cases with bilateral severe permanent HL or deafness before and after UNHS, 22.8% more cases of PHL were identified in the first year of UNHS. Also, the average age of diagnosis of PHL was lower. In the year 2007, 94% of newborns were screened. We found 0.947/1000 newborns with bilateral severe PHL (35.9%) more than before UNHS).

After audiologic and etiologic assessment of the 76 infants who failed screening, 5 (6.58%) were found to have normal hearing, 16 (22.54%) had unilateral and 55 (77.46%) had bilateral SNHL. A non-syndromic genetic cause was present in 25.45% of cases, syndromic in 9%, perinatal cause (31%), congenital CMV infection in 7.27%, bilateral cochlear anomalies without other abnormality in 1.83% and unknown aetiology in 25.45% (Janka Jakubikova et al., 2009).

Yoshinago-Itano et al. (2021) reported that in highly developed countries, significantly better outcomes were found for children identified early through UNHS programs. Early language development predicts later literacy and language development.

Prior to establishing Universal Newborn Hearing Screening programs, the average language, literacy, social-emotional, and speech development of children permanent childhood hearing loss (PCHL) was significantly lower than their peers with normal hearing. Eighteen-year-old children with hearing loss in the United States who were in

the 12th grade between 1974-2003, had average literacy proficiency, between 3rd and 4th grade levels, more than two standard deviations below the developmental functioning of their hearing peers. Wounters et al. (2006) reported that deaf children in the Netherlands had the mean reading levels of first grade hearing students (Busse et al., 2020).

Conclusion

Our UNHS program in Kuwait started 0n 2013 and it's going on. All our governmental hospitals having maternity department are following the program and the screening test being done there nearby discharge of the newborn from the hospital by our audiologists.

Our first screening results showed total birth 105,657, out of which NHS 81976 (77.6%). Passed cases were 72,305 (88.2%), while failed cases 9671 (11.8%) and missed in 23681 (28.9%). Total male showed 42054 (51.3%), while females showed 39922 (48.7%). Kuwaiti nationality showed total of 22060 (26.9%), while higher number of non- Kuwaiti nationality detected 59916 (73.1%).

The second screening results showed, 4284 (44.3%) passed, while out of the referred cases, conductive hearing loss found to be 1369 (14.2%) , 280 (2.9%) showed to have SNHL, 12 (0.12) diagnosed as congenital ear anomalies (external and or middle ear), cases not shown up were 3726 (38.5%).

As the above results showing, the numbers and percentages presented indicate that we really have a high percentage of hearing loss in Kuwait, and we are already working on early identification, intervention and management , that is, by one month age the newborn is fully screened and started diagnosis, by three months age intervention and management started to be done, so by age of six month the infant is fully managed and if needed to fit hearing aids is already done . While, if cochlear implant operation is needed, then, to start preparing for it as soon as possible. Therefore, no delay in managing these children is left behind. Newborns, infant and children having hearing loss are catching up with their normal peers. UNHS is as much as important and valuable in early detecting, identifying and managing hearing loss babies as early as possible.

Drawbacks and possible solutions

1/ Actually, we have missed days for screening, that is, the weekends and holidays, where we miss screening the discharged newborns in these days, but we were able to contact the department to send the cases to our department to take over and do the first screening.

2/ We have large number of missed and not shown up failed first screening for the second screening. Therefore, having a tracking system to follow up our failed cases is important, so we can easily reach the families and recruit the newborns to continue the screening and diagnostic procedures whenever needed.

3/ Non shown up cases and missing these cases can be overcome by data base record system and tracking system. In addition, we can register their phone number, so we can recall the families.

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