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Impact of Consanguineous Marriage on Hearing and Language Disorders: Study Among a Group of Egyptian Children

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ABSTRACT

Background: Even though various research has demonstrated the connection between consanguinity and health issues, consanguineous marriage still common in Egypt with high prevalence rate 35.3%, 23.5% in semi-urban and 17.7% in urban areas.Methods:This study was conducted on 434 native Arabic-speaking Egyptians children (3-10 years) who visited Special Needs Clinic at National Research Centre, among one year presenting with a hearing or /and language problem. They were subjected to psychometric assessment, Conners' Parent Rating Scales-Revised, Autism Diagnostic Interview Revised, Childhood Autism Rating Scale, audiological assessment, and Arabic Preschool Language Scale-4. Participants were classified into 6 subgroups according to the cause of language delay. We estimated the frequency and degree of consanguinity in each group and the association between consanguinity and hearing and language problems.Results:The prevalence of the consanguineous marriage in all participants (n = 434) was 31.6 % with the mean inbreeding coefficient of 0.01208. First cousins' marriages were the most common type of consanguineous marriages (50.3% of consanguineous marriages). Among all participants in the 6 subgroups (n = 434), language delay secondary to cognitive delay showed the highest percentage of consanguineous marriages (35%) followed by autism spectrum disorder (32.8%). No significant association between consanguinity and language problems. Among the 78 participants with sensorineural hearing loss, 35.9% of consanguineous couples (no. = 28 cases) were reported versus 64.1 % of non-consanguineous couples (no. = 50 cases).Conclusions:The Frequency of consanguineous marriages in our participants was 31.6 % which was close to that reported in Egyptian population. Absence of significant association between consanguinity and language problems warrants further investigation and point to the role of genetic - environment interplay in cases of language delay.

KEYWORDS

Consanguineous, marriage, Hearing, Language, Egyptian, children.

ABBREVIATIONS

NRC: National research centre, MR/ID: Mental retardation /intellectual disability, *ASD:* Autism spectrum disorder, *ADHD*: Attention deficit hyperactivity disorder, *SLI:* Specific language impairment, Pi: proportion of the degree of consanguinity, Fi: inbreeding coefficient., *DSM 5*:Diagnostic and Statistical Manual of Mental Disorders, ed. 5, CPRS-R: Conners' Parent Rating Scales-Revised, ADI-R: Autism Diagnostic Interview-Revised, CARS: Childhood Autism Rating Scale, ABR: Auditory Brainstem Evoked Response, PLS4: Arabic Preschool Language Scale-4 (PLS4), RLA: Receptive language age, ELA: Expressive language age, TLA: Total language age, SNHL: Sensorineural Hearing Loss, NDD: Neurodevelopmental Disorder

1 Introduction

Consanguinity is defined as a marriage between second cousins or closer with an inbreeding coefficient greater than or equal to 0.0156 from the standpoint of medical genetics (Bittles, 2001). Even with the abundance of research supporting the link between consanguinity and health issues, certain populations worldwide still follow this marriage practice. Consanguineous marriage is prevalent in Egypt, with a high frequency of 35.3%, particularly among first cousins (86%). It was found to be higher in rural areas (59.9%) than in semi-urban and urban areas (23.5% and 17.7%, respectively) (Aldeeb et al., 2022).

Numerous studies have revealed that maintaining consanguinity homogenizes the gene pool of the population and raises homozygosity. This raises the frequency of genetic illnesses and birth malformations and permits the emergence of recessive harmful mutations (Dahbi et al., 2024). 0.7–7.5% of first cousin couples' children are at higher risk to congenital malformation than children of unrelated partners (Dahdouh et al., 2016). According to American Academy of Pediatrics guidelines, a child with intellectual disability (ID) should have a family history including three generations or more in the pedigree, paying special attention to consanguinity and family members who have developmental delays or ID (Elmasry et al., 2020).

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Many epidemiological studies highlighted the significant influence of consanguinity on children's health, especially within highly consanguineous communities (Bener and Mohammad, 2017). Hearing and language disorders have emerged as areas of particular interest among the potential health consequences. Those disorders significantly affect the development of children and their life quality. The history of consanguineous parents was identified in many children with communication disorders, and consanguinity was identified as risk factors for delayed language in those children (Ahmed et al., 2023; Jijo et al., 2020).

Children's language difficulties encompass a broad spectrum of conditions with varying manifestations. Other developmental, sensory, or physical issues, such as brain damage, hearing loss, autism spectrum disorders (ASD), attention deficit hyperactivity disorder (ADHD), environmental/psychosocial deprivation, intellectual disabilities, or a combination of two or more of these factors, may account for the language difficulties experienced by some of these children. Others have a primary delay for which there is no known cause; these kids are typically classified as having specific language impairment (SLI) (Berkman et al., 2015).

Hearing loss is a well-documented etiology of language delay (Wooles et al., 2018). In Upper Egypt, consanguinity is the most prevalent risk factor for hearing loss in children. 30% to 50% of children with profound childhood deafness were determined to be genetic, 40% to be autosomal recessive, and 10% to be autosomal dominant. Hearing loss can have strongly negative consequences on linguistic, social, learning, and cognitive skills (Bittles and Black,2010).

Public awareness of impact of consanguinity on language and hearing disorder has great role in primary prevention of these disorders. Data on this subject from among the Arabic speaking children in Egypt are sparse compared to Western studies. This cross-sectional study was undertaken to assess the frequency and degree of consanguinity, among a sample of Egyptian children presenting with hearing and language problems. Moreover, the association between consanguinity and hearing and language disorders was studied. Frequency of positive family history for a neurodevelopmental disorder was also assessed.

2 Materials and Methods

The online sample size calculator for proportions, OpenEpi (http://www.openepi.com), was used to determine the sample size (Sullivan and Abramson,2008). This was obtained using the assumption that overall children admitted at the clinic were 8000 children. We used an assumed prevalence of delayed language in the children with consanguineous couples about 59.5%, as reported in a previous study (Sunderajan and Kanhere,2019), 5% (delta) precision. To ensure sufficient power of 90% for the subanalysis, a 95% confidence level for (1-β) was chosen, resulting in a sample size of 356 children with language delay. Also, we used an assumed prevalence of congenital hearing loss in children from consanguinity of 59.5%, as stated in a previous study (Bener et al., 2005), and a 5% (delta) precision. To ensure sufficient power of 90% for the subanalysis, a 95% confidence level for (1-β) was chosen, resulting in a sample size of 78 children.

This observational study was conducted on 434 children (3-10 years) having hearing or /and language disorders, attending the outpatient clinic of the research on children with special needs department, at the Medical Research Centre of Excellence in National Research Centre (NRC), among one year from May 2023 to May 2024. The participants' parents provided written informed consent. Under the approval number 01440324, the National Research Center's Ethics Committee in Cairo, Egypt, gave its approval for this study.

Inclusion criteria for those children were diagnosis of hearing disorder (Sensorineural hearing loss SNHL) and /or language disorder (secondary to ADHD, ASD, cognitive delay, or specific language impairment (SLI) depending upon results of Diagnostic and Statistical Manual of Mental Disorders ed.5 (DSM5), psychometric assessment, Conners, Autism Diagnostic Interview Revised (ADIR) and Childhood Autism Rating Scale (CARS). Children with abnormal neurological examination, abnormal motor development or with any known syndrome were excluded from the study.

2.1 A comprehensive procedure of language assessment was used to examine each participant:

(1) Simple diagnostic procedures include general, neurological, otorhinolaryngological, and patient and parent interviews. During the patient and parent interviews, the degree of consanguinity was ascertained, the symptoms were analyzed, and personal history information including age, sex assigned at birth, and similar and other conditions in the family was recorded. Depending on how consanguineous a couple was, they may be classified into one of five categories: first cousins, second cousins, first cousins once removed, far relation (same tribe), and non-consanguineous. Wright's route approach was used to obtain individual inbreeding coefficient F (Wright, 1992).

$$F = (1/2)^{(n1+n2+1)}$$

(Where n1 and n2 represent the number of generations that separate the individual in the consanguineous marriage from his/her common ancestor (assuming that the common ancestor is not inbred). We calculated the mean inbreeding coefficient (σ) through using this formula:

$$\sigma = \sum P\ i\ F\ i$$

Where Pi means proportion of the degree of consanguinity in the sample, Fi means corresponding inbreeding coefficient.

(2) Clinical diagnostic tools:

(a) Diagnostic and Statistical Manual of Mental Disorders ed.5 (DSM5.TR) for diagnosing ASD, ADHD, ID and SLI (American Psychiatric Association, 2022).

(b)Psychometric assessment according to the patient's condition by applying Arabic version of Stanford Binet intelligence scale, 5th edition or Griffith's developmental scale to judge the participants' intellectual functioning if applicable (Farag, 2013; Alin-Åkerman and Norberg, 1991).

(c) Conners' Parent Rating Scales-Revised (CPRS.R) for determining the ADHD severity (Conners, 1997).

(d)Autism Diagnostic Interview-Revised (ADIR) for diagnosis of ASD and the Childhood Autism Rating Scale (CARS) for determining ASD severity (Schopler,2010; Rutter et al., 2003).

(e)Audiological assessment: using Auditory Brainstem Evoked Response (ABR) and tympanometry for confirming the type and degree of hearing loss.

(f)Arabic Preschool Language Scale for obtaining language age-4 (PLS4): The scale allows the examiner to confirm the existence of language development delay by providing raw and scaled scores for receptive, expressive, and total language abilities (El-Sady et al., 2011).

2.2 Statistical analysis

Data was collected in spreadsheet excel then by using the SPSS version 22. All quantitative variables were described by measure of centralization and standard deviation ($\bar{x}$±SD). On other hand the qualitative variables were represented by (the frequency and the percentage). For predication of the association between independent variables (consanguinity) and outcome (disorder), Monte Carlo Sig 2 sided, and Pearson Chi Square were applied. Kolmogorov-Smirnova and Shapiro Wilk test were applied for examining normality of the quantitative variables. Mann Whitney U test was used for comparing different means.

3 Results

This study was carried out on 434 children: 321 male (74%) and 113 female (26%) presenting with language and/or hearing problems. Children ages ranged from 3 -10 years with mean of 5.34±2.14 years. The preliminary assessment of the language age of all participants revealed that all the participants had language delay. Their Receptive language ages (RLA), expressive language ages (ELA) and total language ages (TLA) were less than what is expected from children with the same chronological ages. The audiological assessment for all participants revealed that 78 cases had sensorineural hearing loss (SNHL), ranging from mild to profound hearing loss. 55 cases had SNHL without neurodevelopmental disorders (NDD), and 23 cases had SNHL associated with NDD such as ASD and Down syndrome (to investigate the relation between consanguinity and presence of SNHL with a neurodevelopmental disorder) (Table 1). In this study, cases with language delay due to SNHL (78 cases) were classified and discussed separately in details.

Thus, the participants were finally divided into six subgroups according to the cause of the language delay. Diagnoses included attention deficit hyperactive disorders (ADHD) (no.=18; 4.1%), cognitive delay (no.=109; 25.1%), autism spectrum disorders (ASD) (no.=193; 44.5%), specific language impairment (SLI) (no.=36; 8.3%), Sensorineural hearing loss (SNHL) (no.=55; 12.7%) and SNHL associated with neurodevelopmental disorder (NDD) (no.=23; 5.3%). Language and hearing disorders were higher in males than females in all six groups with significant statistical difference (P = 0.00).

3.1 Frequency of consanguinity:

The frequency of consanguineous marriage among all children (n=434) presenting with language or hearing problems was 31.6% (n = 137) versus 68.4% (n = 297) for non-consanguineous marriage. First cousin marriages represented the most common degree of consanguinity (15.9%) of total marriages; it also consisted of 50.3% of consanguineous marriages, followed by second cousin marriages (9.2%), distant relations (3.9%), and lastly, first cousins once removed marriages (2.5%). When comparing the chronological age of children born in consanguineous couples and non-consanguineous couples, there were no statistically significant difference (5.36±2.15 versus 5.33±2.14 years, P = 0.787).

Among all participants in the 6 subgroups (n =434), language delay secondary to cognitive delay showed the highest percentage of consanguineous marriages (35%) followed by autism spectrum disorder (32.8%), then other groups of language disorders with significant statistical difference (P = 0.02). However, the degree of consanguinity didn't differ significantly across the 6 subgroups.

The current study showed that consanguineous marriages were reported in 14.6% of cases with SNHL without neurodevelopmental disorders and 5.9% in cases of SNHL associated with neurodevelopmental disorders (i.e., total percentage = 20.5%). These results were reported despite the relatively small sample size compared to the overall number of cases (78 out of 432 cases (Table 2).

3.2 Family History for neurodevelopmental disorders:

On studying family history of another cause for language delay across the six subgroups. Family history of ASD and ADHD were significantly reported, as shown in (Table 3).

3.3 Effect of consanguinity on language problems:

Comparing the language age between children of consanguineous and non-consanguineous marriage showed no significant difference regarding RLA (P is 0.166), ELA (P is 0.158), and TLA (P is 0.162) ages.

3.4 Effect of consanguinity on hearing problems:

Among the 78 participants with SNHL in the current study,

Table 1 Clinical characteristics of studied groups.

Language parameters of 434 participants						
	Mean ± SD	Minimum	Maximum	Percentiles		
				25	50	75
RLA	6.8	0.11	2 ± 1.29	2.6	1.8	1
ELA	6.8	0.11	1.85 ± 1.18	2.4	1.5	1
TLA	6.70	0.11	1.88 ± 1.22	2.5	1.6	1

Degree of hearing loss in 78 cases witd SNHL:			
	No.of cases witdout NDD (no. = 55) %	No.of cases witd NDD (no. = 23) %	Total (no. = 78) %
Mild SNHL	11 (20.0)	2 (8.7)	13(16.7)
Moderate SNHL	19 (34.5)	8(34.8)	27 (34.6)
Moderately severe SNHL	5 (9.1)	5 (21.7)	10 (12.8)
Severe SNHL	12 (21.8)	3 (13)	15 (19.2)
Profound SNHL	8 (14.5)	5 (21.7)	13 (16.7)
Total (no. = 78) %	55 (70.5)	23 (29.5)	78 (100)

RLA: receptive language age, ELA: expressive language age, SNHL: sensorineural hearing loss, NDD: neurodevelopmental disorder

35.9% of consanguineous couples (no.= 28 cases) were reported versus 64.1 % of non-consanguineous couples (no.= 50 cases), with a significant statistical difference (p value =0.001) as shown in Table 4.

Sever and profound SNHL were reported more in consanguineous marriages compared to non-consanguineous marriages. Statistical analysis for the 55 cases with SNHL showed that severe SNHL were 12 out of 20 consanguineous cases (60%) and profound SNHL were 8 out of 20 consanguineous cases (40%). No consanguineous cases present with mild, moderate or moderately severe SNHL. This finding continued the 23 cases of SNHL associated with NDD (Table 5). Moreover, on analysing the relation between degree of consanguinity and degree of SNHL, first and second cousin marriages showed more severe degrees of hearing loss in 55 cases of SNHL. However, the degree of consanguinity didn't affect the degree of SNHL in presence of neurodevelopmental disorder (Table 6).

4 Discussion

Consanguineous unions remain frequent and widely practiced in certain areas of the world (Dahdouh et al., 2016). Compared to other countries in the Middle East, some areas in Egypt showed a high prevalence of consanguineous marriages reaching 68%. An increased incidence of some common diseases, including hearing and mental disorders, in consanguineous marriages has been reported in previous studies (Bener and Mohammad, 2017). Several studies suggested that consanguinity is associated with an increased risk of ASD and other language disorders (Roy et al., 2020; Ahmed et al., 2023). A high link between consanguineous marriages and some genetic abnormalities that can affect the language and cognitive skills has been documented (Shawky et al., 2011). Additional research also suggested that consanguinity can significantly increase the prevalence of mental health problems and developmental delays, including speech and language disorders (Bittles and Black,2010; Dahbi et al., 2024).

The results of the present study among a sample of Egyptian Children presenting with language or hearing problems revealed a consanguineous marriage rate of 31.6% among their parents, with first cousin marriages were about 50.3% of consanguineous marriages (15.9% of the study group). This finding agreed with average consanguinity rate reported in Egypt which was about 27.4 and

Table 2 Rate of consanguinity and degrees of Consanguinity among the six subgroups.

	Non-Consanguineous (n=297)	Consanguineous (n= 137)	Total (n=434)	P value	First (n= 69)	Second (n= 40)	First once (n= 11)	Distant (n= 17)	Total (n= 137)	P value*
1-ADHD	12 (4%)	6 (4.4%)	18(4.1%)		3 (4.3%)	2 (5%)	0 (0%)	1 (5.9%)	6 (4.4%)	
2.Cognitive Delay	61 (20.5%)	48(35%)	109(25.1)		29 (42%)	12(3%)	3(27.3%)	4(23.5%)	48(35%)	
3. ASD	148 (49.8%)	45 (32.8%)	193(44.5%)		23(33.3%)	12(3%)	3(27.3%)	7(41.2%)	45 (32.8%)	
4. SLI	26 (8.8%)	10 (7.3%)	36(8.3%)	0.020	4 (5.8%)	4(10%)	2(18.2%)	0 (0%)	10 (7.3%)	0.08
5.SNHL without NDD	35 (11.8%)	20 (14.6%)	55(12.7%)		7(10.1%)	7(17.5)	2(18.2%)	4(23.4%)	20 (14.6%)	
6.SNHL with NDD	15 (5.1%)	8 (5.9%)	23(5.3%)		3 (4.3%)	3(7.5)	1 (9.1%)	1(5.9%)	8 (5.9%)	
Total	297(68.4%)	137 (31.6%)	434(100%)		69 (15.9%)	40 (9.2%)	11(2.5%)	17(3.9%)	137(100%)	

*Monte Carlo Sig 2 sided, Pearson Chi Square

ADHD: attention deficit hyperactive disorder, ASD: autism spectrum disorder, SLI: specific language impairment, SNHL: sensorineural hearing loss, NDD: neurodevelopmental disorder

Table 3 Family history of another cause for language delay across the six subgroups.

		ADHD (no =18)	ASD (no = 193)	Cognitive delay (no =109)	SLI (no = 36)	SNHL (no = 55)	SNHL with NDD (no = 23)	Total (n=434)	P value
FH of DS	No	18 (4.3)	189(44.8)	103 (24.4)	35 (8.3)	54 (12.8)	23 (5.5)	422(97.2)	
	Yes	0 (0.0)	4 (33.3)	6 (50-.0)	1 (8.3)	1 (8.3)	0 (0)	12(27.7)	0.684b
FH of ASD	No	15 (3.8)	171(43.5)	103 (26.2)	36 (9.2)	46 (11.7)	22 (5.6)	393(90.6)	
	Yes	3 (7.3)	22 (53.7)	6 (14.6)	0 (0.0)	9 (22.0)	1 (2.4)	41(9.4)	0.050b
FH of cognitive delay	No	16 (4.2)	177(46.8)	88 (23.3)	32 (8.5)	45 (11.9)	20 (5.3)	378(87.1)	
	Yes	2 (3.6)	16 (28.6)	21 (37.5)	4 (7.1)	10 (17.9)	3 (5.4)	56(12.9)	0.088b
FH of ADHD	No	17 (4.4)	185(47.7)	97 (25)	34 (8.8)	38 (9.8)	17(4.4)	388 (89.4)	
	Yes	1 (2.2)	8 (17.4)	12 (26.1)	2 (4.3)	17 (37)	6 (13)	46(10.6)	0.000b
FH of SLI	No	15 (3.8)	176(44.9)	96 (24.5)	34 (8.7)	49 (12.5)	22 (5.6)	392(90.3)	
	Yes	3 (7.1)	17 (40.5)	13 (31.0)	2 (4.8)	6 (14.3)	1 (2.4)	42(9.7)	546b
Similar Condition	No	15 (3.9)	175(45.5)	92 (23.9)	33 (8.6)	51 (13.2)	19 (5)	385(88.7)	
	Yes	3 (6.1)	18 (36.7)	17 (34.7)	3 (6.1)	4 (8.2)	4 (8.1)	49 (11.3)	0.377b
Total		18(4.1)	193(44.5)	109(25.1)	36(8.3)	55(12.7)	23(5.3)	434(100)	

b Monte Carlo Sig 2-sided

FH: family history, DS: Down syndrome, ADHD: attention deficit hyperactive disorder, ASD: autism spectrum disorder, SLI: specific language impairment, SNHL: sensorineural hearing loss, NDD: neurodevelopmental disorder

Table 4 Relation between consanguinity and degree of hearing loss in the 78 cases of SNHL.

Degree of Hearing loss	Non consanguineous (n=50), %	Consanguineous (n = 28), %	Total (n = 78), %	P value
Mild	13 (26)	0 (0.0)	13(16.7)	< 0.001
Moderate	27 (54)	0 (0.0)	27(34.6)	
Moderately severe	9 (18)	1 (3.6)	10(12.8)	
Severe	0 (0.0)	15 (53.6)	15 (19.2)	
Profound	1 (2.0)	12 (42.9)	13(16.7)	
Total	50(64.1)	28 (35.9)	78(100)	

*Monte Carlo Sig 2 side

Statistically significant at P < 0.05.

Table 5 Relation between degree of hearing loss and degree of consanguinity in the 55 cases of SNHL.

Degree of Hearing loss	Non consanguineous (n=35), %	Consanguineous (n = 20), %	Total (n =55) %	P value	First (n = 7)	Second (n=7)	First once (n=2)	Distant (n=4)	Total (n=20) %	P value
Mild	11 (31.4)	0 (0.0)	11 (20.0)	< 0.001	0 (0.0)	0 (0.0)	0 (0.0)	0(0.0)	0(0.0)	< 0.001
Moderate	19 (54.3)	0 (0.0)	19(34.5)		0 (0.0)	0 (0.0)	0 (0.0)	0(0.0)	0(0.0)	
Moderately severe	5 (14.3)	0 (0.0)	5(9.1)		0(0.0)	0 (0.0)	0 (0.0)	0(0.0)	0(0.0)	
Severe	0 (0.0)	12 (60.0)	12(21.8)		3 (42.9)	5(71.4)	2 (100)	2(50.0)	12(60.0)	
Profound	0 (0.0)	8 (40.0)	8(14.5)		4 (57.1)	2(28.6)	0(0.0)	2(50.0)	8(40.0)	
Total	35(63.6)	20(36.4)	55(100)		7(35)	7(35)	2(10.0)	4(20.0)	20(100)	

*Monte Carlo Sig 2 side

Table 6 Relation between degree of hearing loss and degree of consanguinity in the 23 cases of SNHL associated with NDD.

Degree of hearing loss	Non consanguineous (n=15) %	Consanguineous (n=8) %	Total (n=23) %	p value	First (n = 3)	Second (n=3)	First once (n=1)	Distant (n=1)	Total (n=8) %	P value
Mild	2 (13.3)	0 (0.0)	2 (8.7)	0.003*	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0.087
Moderate	8 (53.3)	0 (0.0)	8 (34.8)		0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
Moderately severe	4 (26.7)	1 (12.5)	5 (21.7)		1(33.3)	0 (0.0)	0 (0.0)	0 (0.0)	1(12.5)	
Severe	0 (0.0)	3 (37.5)	3(13.0)		1(33.3)	1 (33.3)	0 (0.0)	1 (100.0)	3 (37.5)	
Profound	1 (6.7)	4 (50.0)	5 (21.7)		1(33.3)	2 (66.7)	1(100.)	0 (0.0)	4 (50)	
Total	15(65.2)	8 (34.8)	23(100)		3(37.5)	3(37.5)	1(12.5)	1(12.5)	8(100)	

*Monte Carlo Sig 2 side

may exceed 30% (Ahmed, 2014; El-Nekhely et al., 2008).

Moreover, regarding the rate of consanguinity across several subgroups of language disorders in the current study, the highest percentage of consanguinity was seen in language problems due to cognitive delay followed by ASD. Also, the degree of consanguinity did not differ significantly across subgroups in our study. These findings agreed with other studies in communities known with high consanguinity rates which concluded that parental consanguinity is unlikely to be alone a risk factor for ASD (Alshaban et al., 2019; Yousuf et al., 2023), including Egyptian population (Meguid et al., 2018). The impact of consanguinity on language development may be affected by an interaction of genetic, environmental, and sociocultural factors (Hussein et al., 2011; Meguid et al., 2021). A recent meta-analysis by Carlsson et al., 2023 investigating twins and siblings studies, stated that exposure to environmental factors contribute to causal pathways in neurodevelopmental disorders after controlling familial confounding.

In this study, family history of ASD and ADHD are significantly reported across the six subgroups of language delay which is consistent with the well-documented heritability of these two neurodevelopmental disorders. This comes in accordance with previous studies which reported that among the risk factors causing communication disorders, positive family history of speech and language disorder was found to be a prominent causative factor (Sunderajan and Kanhere,2019; Jijo et al., 2020). Also, research showed that children with ASD have a higher incidence of neurodevelopmental abnormalities in their families as delayed language, ID and ASD (Alshaban et al., 2019).

Prevalence of language delay has been always difficult to estimate because in many cultures, there is a belief that language delay run in families and it is not a source of alarm (Sunderajan and Kanhere,2019). Genetic counseling should start with a detailed family

history. Further genetic counseling should be delivered if there are already known genetic disorders within the family (Roy et al., 2020). Preventive strategies regarding language disorders in Arabic speaking children should consider those risk factors and to refer them for early detection and intervention if necessary.

In the current study, sever and profound SNHL were reported more in consanguineous marriages compared to non-consanguineous marriages. Hearing loss was more severe in first and second marriages in SNHL cases. Consanguinity was the most prevalent risk factor in almost 60% of individuals with SNHL as reported in some studies (Patil et al., 2018; Samy et al., 2018)

Furthermore, there was previous evidence linking SNHL to neurodevelopmental disorders as Down syndrome and ASD which can worsen their developmental difficulties (Tedeschi et al., 2015; Szymanski et al., 2012). 10% of children with cognitive impairment also have hearing loss (Harris, 2006). In this study, 23 children of 78 had SNHL linked to neurodevelopmental condition. This result can be explained by a more comprehensive understanding of the complex interaction between genetics and developmental issues in these groups.

5 Conclusion

The frequency of consanguineous marriages in our participants was 31.6% which was close to that reported in Egyptian population. First cousin marriages were about 50.3% of consanguineous marriages. The absence of significant association between consanguinity and language problems in the current study warrants further investigation and point to the role of genetic - environment interplay in cases of language delay. Sever and profound SNHL were reported more in consanguineous marriages compared to non-consanguineous marriages. Identifying the elevated risk of severe and profound SNHL linked to first and second cousin marriages can help healthcare professionals for effectively targeting early intervention and support to the affected families. This will help improving the prognosis for children who are at risk.

Limitations

The present study tried to highlight the impact of consanguinity on an important presentation in special needs facilities, which is language delay. However, the study was limited by insufficient knowledge of ancestral data. A group of participants' parents in the study had a recall bias when it came to information about their families. Genome-based calculation of inbreeding co- efficient will provide better evaluation to consanguinity burden than using pedigree- based assessment. Also, the limited number in some subgroups (as ADHD and SNHL) may affect the generalizability of the results. Future research with significantly larger sample sizes will enhance generalizability of the findings. This study randomly collected a sample of children presenting with language delay without selecting specific causes and the percentage of subgroups represented different causes of delayed language development.

Authors' Contributions

Conceptualization, study design, administration, clinical and genetic methodology were performed by NA.M. Clinical methodology, collection, analysis of the data and writing the first draft of the manuscript were performed by SA.N, FH and HSA All authors shared in analysis and interpretation of the data reviewed, edited and approved the final manuscript.

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Ethics Approval and Consent to Participate.

The study was approved by the medical research ethics committee of the National Research Centre and carried out according to the latest version of the Helsinki Declaration of 1975 with the approval number: 01440324. The participants and their parents were asked to sign an informed consent prior to their participation in the study.

Consent for Publication

All authors agreed the possible publication of our article on Journal of Otology. The participant has consented to the submission of the article to the journal.

Availability of Data and Materials

All the clinical data used to support the findings of this study are available from the corresponding author on reasonable request.

Competing Interests

The authors report there are no competing interests to declare.

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