Proceedings of the Pakistan Academy of Sciences: B. Life and Environmental Sciences 58(3): 75-82 (2021)

ISSN (Print): 2518-4261; ISSN (Online): 2518-427X
http://doi.org/10.53560/PPASB(58-3)667

Pakistan Academy of Sciences

Research Article

Prevalence and Association of Different Levels of Intellectual Disability with Prenatal, Perinatal, Neonatal and Postnatal Factors

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Abstract: Intellectual disability (ID), also called mental retardation, is defined by below-average intelligence or mental aptitude as well as a lack of life skills. It has a significant association with residency, family history, and chromosomal disorder. An analytical cross-sectional study was performed over a period from December 2019 to January 2021 in special educations centers and hospitals of Lahore, Faisalabad, Shahkot, Sialkot, Gujranwala and Sangala, Punjab, Pakistan. This study was aimed to access the prevalence and risk factors of Intellectual disability (ID). Questionnaires were designed and filled with the help of general doctors, pediatricians, and psychiatrists who diagnosed both intellectual and adaptive functioning of individuals Association between these parameters was analyzed by using SPSS software (Chi-square test) between ID and risk factors and the level of significance was considered as $P<0.05$. The frequency of mild, moderate, severe, and profound ID was 46.7 %, 32.1 %, 14.6 %, and 6.7 % respectively. More males (56.82 %) as compared to females 43.17 % were observed.

Keywords: Neonatal; Perinatal; Postnatal; Prenatal and Prevalence.

1. INTRODUCTION

Intellectual disability (ID), characterized by embryonic development impairments in intellectual function and adaptive behavior which are determined by the low-level intelligence quotient (< 70) [1,2]. Intellectual disability (ID) can be divided into a mild group (IQ: 50 to 70), moderate group (IQ: 35 to 49), severe group (IQ: 20 to 34), and profound group (IQ below 20) which depends on IQ level [3]. Approximately 1-3 % of the world population is getting affected by this syndrome [4]. Accordingly, the occurrence of Intellectual disability (ID) is about 2-3 % but some areas only have 1 % of occurrence. In developed and undeveloped countries, risk factors of ID vary from region to region. According to the latest survey conducted, for mental retardation among 8-year children about 13.6/1000.

The prevalence rate is recorded for the surveillance year 2010. 2.5 % of the Pakistani population suffers from ID and out of this about 55% of the affected population belongs to the province Punjab and 28.4 % in Sind according to the National Census of Pakistan 1998. However; the incidence rate may vary from mild ID (65/1000) to serious (19.1/1000) [5].

Children having ID show low expressing level with having speaking and language development difficulties. There are various etiological and heterogeneous forms of ID. Some of these are deprived mental abilities that may cause birth-related injuries or infections [6]. Genetics, as well as environmental factors, are involved in ID.

Received: July 2021; Accepted: September 2021
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Malnutrition repeated prenatal period without break, prenatal/ perinatal brain ischemia, infections after birth, emotional, social deprivation experienced, exposure to chemicals during pregnancy, and inadequate medical services are non-genetic causes of ID [7]. Fifty percent of intellectual disabilities have a genetic basis out of which 25-50 % can be divided into chromosomal aberrations or transformations in most gene and metabolic disorders [8].

In Pakistan, one of the main reasons behind the higher incidence rate of genetic diseases (ARID with 6.2/100 live births and 1.1/100 cases of severing ID) is due to a high level of endogamy. The present study was aimed at assessing the prevalence rate, the association between ID, demographic variables, and etiology factors such as prenatal, perinatal, and postnatal. Behaviors such as sensory impairments symptoms as well as signs of disorders were also included in this study. This study was performed over a period from December 2019 to January 2021 in special educations centers and hospitals of Lahore, Faisalabad, Shahkot, Sialkot, Gujranwala and SangalaPunjab, Pakistan. The primary goal of this research is to provide information to individuals and groups who are recognized to be at risk for ID, as well as their family members and to those who deal with them.

2. MATERIALS AND METHODS

2.1 Nature of Study

Hospitals and special education centers based analytical coss-sectional study was performed over a period from December 2019 to January 2021 in special educations centers and different hospitals of Lahore, Faisalabad, Shahkot, Sialkot, Gujranwala and Sangala, Punjab, Pakistan.

2.2 Questionnaire Design and Data Collection

Questionnaires were designed to collect information about variables such as age, area, gender, level of ID (mild, moderate, severe, and profound), family history, and genetic factors (Monogenic and chromosomal disorders). Non-genetic factors such as prenatal (before birth), perinatal (around birth) and postnatal factors (in infancy or childhood) include behavior, sensory impairments symptoms as well as signs of disorders. Questionnaires were filled with the help of general doctors, pediatricians, and psychiatrists who diagnosed both intellectual and adaptive functioning of individuals. They categorized the level of ID with different IQ test measurements and adaptive functioning is assessed through standardized measures with the individual and interviews with others, such as family members, teachers, and caregivers.

Physical examination by mental health clinicians and pediatricians was also done to categorize disorders with the help of symptoms associated with ID e.g. Down syndrome. Parents' meetings were also arranged for the completion of these questionnaires. Ethical clearance was taken on 10th December 2019 from the institutional Ethical committee of the Zoology department of Lahore College for Women University of Lahore (Report number: RERC/LCWU/Zoo 681). Consent forms of sampled ID individuals were signed from respective families. Permission from the respective institutions and hospitals was also taken.

2.3 Statistical Analysis

Statistical packages for social sciences (SPSS), version 22 were used to analyze the recorded data. Chi-Square ($\chi 2$) technique was used to test the association between two qualitative parameters. P-value at <0.05 was considered as significant, P-value at <0.01 was considered as highly significant and P-value at >0.05 was considered as insignificant.

3. RESULTS

3.1 Distribution of variables

About 315 patients of ID were collected in which 56.2 % (n=177) were male and 43.8 % (n=138) were female. 36.50 % (n=114) cases come from rural area while 63.50 % (n=200) cases come from urban areas. The frequency of mild, moderate, severe and profound ID were 46.7 % (n=147), 32.0 % (n=101), 14.6 % (n=46) and 6.7 % (n=21) respectively. Frequency of parent's consanguinity was 72.1 % (n=227) and non-cousin marriage was 27.9 % (n=88) (Table 1).

In this study risk factors for ID at prenatal,

perinatal, neonatal and postnatal stages were also studied. At the prenatal stage, genetic and non-genetic factors were recorded in this study. In genetic factors, two types of disorders were including one is chromosomal disorders and the other one is related to the monogenic disorder.

Out of 315 cases of ID, the prevalence of chromosomal disorders is 15.87 % (n= 50) which includes 94 % (n=47) were Down syndrome, 2 % (n=1) with Pradarwilli syndrome and 4 % (n=2) with Klinefelters syndrome while the other patients show no disorders. 42.53 % (n=134) patients shows single gene disorders in which 73.88 % (n=99) microcephaly, 3.73 % (n=5) were phenylketonuria, 2.24 % (n=3) hypothyroidism, and 20.15 % (n=27) were other diseases. Environmental influences include deficiency of Iodine, malnutrition, exposure to chemicals, maternal influences, Rh incompatibility were studied with incidence of 4.4 % (n=14), 22.2 % (n=70), 5.4 % (n=17), 7.6 % (n=24), 9.5 % (n=30) respectively. 50.9 % (n=160) have unexplained etiology (Table 2).

At the time of birth (perinatal) prematurity, birth trauma, complication in delivery causes were observed with 9.8 % (n=31), 1.3 % (n=4), and 18.1 % (n=57) incidence rate while 70.80 % (n=223) not show any cause. During neonatal stage .6 % (n=2) cases of septicemia and 22.6 % (n=71) cases of jaundice were observed in ID patients. 20.6 % (n=65) have Unexplained etiology and 56.2 % (n=177) have no causes.

Brain infection, 22.5 % (n=71) head injury, 8.6 % (n=27) lead exposure .3 % (n=1) and 13.3 % (n=42) malnutrition causes were calculated at postnatal stage while 55.24 % (n=174) have no cause at this stage. Distribution of these non-genetic risk factors with respect to ID levels is explained in Table 3.

3.1.1 Association of Intellectual disability with d emographic variables

Table 1 is describing that gender, parent consanguinity has some non-significant effect with ID, while residency and family history has significant result with ID.

3.1.2 Association of Intellectual disability with prenatal risk factors (Genetic variables)

Chromosomal disorder and ID level have significant relations. It shows that ID has significantly associated with different syndromes like Down's syndrome, Fragile X syndrome, Prader-Willi syndrome and Klinefelter's syndrome. Gene mutation diseases (Microcephaly, Phenylketonuria, Hypothyroidism and other disorders) have insignificant effects with ID (Table 2).

3.1.3 Association between ID with other variables (non-Genetic variables)

Family history is significantly associated with ID. As shows that prenatal risk factors have some non-significant effects on IQ level. While perinatal factors (Placental dysfunction, severe prematurity, birth trauma, and complicated delivery) have a significance association Neonatal factors (Septicemia Jaundice) and postnatal are also significantly associated with the ID (Table 3). Some variables are associated with signs and symptoms

Table 1. Distribution and association of demographic variables with intellectual disability patients

		Frequency of mild ID	Frequency of moderate ID	Frequency of severe ID	Frequency of profound ID	Total Percentage	P-Values
Residency	Rural	36 (11.4 %)	29 (9.2 %)	35 (11.1 %)	15 (4.8 %)	115 (36.5 %)	**.000**
	Urban	111 (35.2 %)	72 (22.9 %)	11 (3.5 %)	6 (1.9 %)	200 (63.5 %)	(53.942,3)
Parent consanguinity	Yes	101 (32.1 %)	76 (24.1 %)	34 (10.8 %)	16 (5.1 %)	227 (72.1 %)	**.662**
	No	46 (14.6 %)	25 (7.9 %)	12 (3.8 %)	5 (1.6 %)	88 (27.9 %)	(1.587)

Table 2. Distribution and association of risk factors of intellectual disability

Characteristics	Intellectual Disability				Total Percentage	P-Values (χ2,df)
	Mild	Moderate	Severe	Profound		
Prenatal Factors						
1. Genetic Factors Chromosomal disorder						
Down's syndrome	12 (3.8 %)	25 (7.9 %)	8 (2.5 %)	2 (0.6 %)	47 (14.9 %)	
Pradarwilli syndrome	0 (0.0 %)	0 (0.0 %)	1 (0.3 %)	0 (0.0 %)	1 (0.3 %)	**0.004** (24.355,9)
Klinefelter's syndrome	0 (0.0 %)	2 (0.6 %)	0 (0.0 %)	0 (0.0 %)	2 (0.6 %)	
NIL	35(42.9 %)	74(23.5 %)	37(11.7 %)	19(6.0 %)	265 (84.1 %)	
Single Gene Disorder						
Microcephaly	56 (17.8 %)	24 (7.6 %)	13 (4.1 %)	6 (1.9 %)	99 (31.4 %)	
Phenyl	1 (0.3 %)	1 (0.3 %)	3 (1.0 %)	0 (0.0 %)	5 (1.6 %)	**0.052** (20.915,12)
Hypothyroidism	2(0.6 %)	0 (0.0 %)	1 (0.3 %)	0 (0.0 %)	3 (1.0 %)	
Unexplained disorder	8 (2.5 %)	14 (4.4 %)	4 (1.3 %)	1 (0.3 %)	27 (8.6 %)	
NIL	74 (23.5 %)	62(19.7 %)	23 (7.3 %)	13(4.1 %)	172 (54.6 %)	
Missing	6 (1.9 %)	0 (0.0 %)	2 (0.6 %)	1 (0.3 %)	9 (2.9 %)	
2. Environmental factors						
Iodine	3 (1.0 %)	7 (2.2 %)	3 (1.0 %)	1 (0.3 %)	14 (4.4 %)	
Malnutrition	35 (11.1 %)	22 (7.0 %)	6 (1.9 %)	7 (2.2 %)	70(22.2 %)	
Exposure to chemicals	13 (4.1 %)	3 (1.0 %)	1(0.3 %)	0 (0.0 %)	17 (5.4 %)	
Maternal infection	14 (4.4 %)	5 (1.6 %)	5 (1.6 %)	0 (0.0 %)	24(7.6 %)	
Rh income	16 (5.1 %)	5 (1.6 %)	7(2.2 %)	2(0.6 %)	30(9.5 %)	**0.077** (23.350,15)
Others	66 (21.0 %)	59 (18.7 %)	24 (7.6 %)	11(3.5 %)	160(50.8 %)	

Table 3. Distribution and Association of Non-Genetic Risk Factors of Intellectual Disability

Prenatal factors						
	Intellectual disability				**Total Percentage**	**P-Values**
Characteristics	**Mild**	**Moderate**	**Severe**	**Profound**		**(χ2,df)**
Birth time prematurity	19 (6.0 %)	7(2.2 %)	1(0.3 %)	4 (1.3 %)	31(9.8 %)	
Birth trauma	2 (0.6 %)	0(0.0 %)	0(0.0 %)	2 (0.6 %)	4(1.3 %)	**0.004** (23.966, 9)
comp delivery	28 (8.9 %)	17(5.4 %)	11(3.5 %)	1(0.3 %)	57 (18.1 %)	
Others	98(31.1 %)	77(24.4 %)	34(10.8 %)	1 (4.4 %)	23 (70.8 %)	
Neonatal Factors						
Septicemia	1 (0.3 %)	0 (0.0 %)	0 (0.0 %)	1 (0.3 %)	2 (0.6 %)	
Jaundice	33 (10.5 %)	22 (7.0 %)	13(4.1 %)	3 (1.0 %)	71 (22.5 %)	
Unexplained Etiology	41 (13.0 %)	14 (4.4 %)	10(3.2 %)	0 (0.0 %)	65 (20.6 %)	**0.005** (23.422,9)
NIL	70 (22.2 %)	64 (20.3 %)	23(7.3 %)	16(5.1 %)	173(54.9 %)	
Missing	2 (0.6 %)	1 (0.3 %)	0 (0.0 %)	1 (0.3 %)	4 (1.3 %)	
Postnatal Factors						
Brain infection	42(13.3 %)	21 (6.7 %)	9 (2.9 %)	0 (0.0 %)	72 (22.9 %)	
Headinjury	14 (4.4 %)	2 (0.6 %)	8 (2.5 %)	3 (1.0 %)	27 (8.6 %)	
Lead exposure	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	1 (0.3 %)	1 (0.3 %)	
Malnutrition	22 (7.0 %)	7 (2.2 %)	9 (2.9 %)	4 (1.3 %)	42 (13.3 %)	**.000** (44.146,1)
NIL	69 (21.9 %)	71 (22.5 %)	20 (6.3 %)	13 (4.1 %)	173 (54.9 %)	

that are highly linked with ID like delay in sitting, delay in standing, delay in walking, difficulty in seeing at daytime, difficulty in seeing at night, difficulty in hearing, difficulty in understanding, difficulty in moving arm, loss of consciousness, lack of learning, not able to speak at all, not name object and mentally backward. (Table 4).

3.1.4 Association between Physical disorder and Intellectual disability

The results are describing here that physical disorder somehow, is no more associated with the ID, as an only floppy limb, problem in feeding and lump a navel has a significant association with IDs (Table 5).

Table 4. Association of ID with Signs and Symptom

Variable * IQ	Chi-Square value	P-Value
Delay in sitting	11.728	.008
Delay in standing	11.374	.010
Delay in walking	9.267	.026
Difficulty in seeing at daytime	7.514	.057**
Difficulty in seeing at night	7.811	.050**
Difficulty in hearing	16.096	.001
Difficulty in understanding	11.508	.009
Difficulty in moving arm	20.055	.000
Loss of consciousness	1.262	.738**
Lack of learning	6.900	.075**
Can’t speak at all	21.991	.000
Can’t name object	54.668	.000
Mentally backward	5.162	.000

Table 5. Showing the Association between Physical Disorder and Intellectual Disability

Variable * IQ	Chi-Square value	P-Value
Floppy Limb	21.7	0
Problem in Feeding	26.216	0
Cleft Lip	2.494	.476**
Large Head	6.415	.093**
Weak limbs	7.62	.055**
Club feet	4.542	.209**
Lump on Back	1.979	.577**
Lump at navel	15.275	0.002

4. DISCUSSION

In this study 315 patients of ID were collected in which 56.2 % (n=177) were males and 43.8 % (n=138) were females. 36.50 % (n=114) cases were come from rural area while 63.50 % (n=200) cases from urban areas. These results can be compared with one study conducted in Assiut, Egypt in which the total number of cases was 90, 63 males and 27 females, 76 % of cases were coming from rural areas while 24 % of cases were coming from urban areas [10]. The frequency of mild, moderate, severe and profound ID were 46.7 % (n=147), 32.0 % (n=101), 14.6 % (n=46) and 6.7 % (n=21) respectively, which is relatable with a study in which non-genetic ID patients were 97 in number which includes 24 % mild ID, 40 % moderate, 23 % severe-profound and 10 % unspecified ID [11].

Frequency of parent's consanguinity was 72.1 % (n=227) and non-cousin marriage was 27.9 % (n=88). In contrast, a study conducted to investigate the parental consanguinity among mentally retarded children found that (63 %) were born to non-consanguineous marriages [12]. In the present study, male gender remains dominant in all types of ID. This is in agreement with one study in which the gender ratios for severe/profound ranges of cognitive impairment (i.e., male-to-female ratio, 1.2:1in the severe range of mental retardation and 1.4:1 in mild mental retardation.

In this study, 315 cases of ID the prevalence of chromosomal disorders is 15.87 % (n= 50) which includes 94 % (n=47) were Down syndrome, 2 % (n=1) Pradarwilli syndrome and 4 % (n=2) with Klinefelter syndrome while the other patients show no disorders which is relatable with a study done by Harbour and Maulik [14]. Most cases were of unknown etiology (30-50 %). Down syndrome is the most common known cause and accounts for about 5-20 % of all cases. Congenital hypothyroidism accounts for 1-2 % of cases 42.53 % (n=134) patients shows single gene disorders in which 73.88 % (n=99) were microcephaly, 3.73 % (n=5) were phenylketonuria, 2.24 % (n=3) hypothyroidism and 20.15 % (n=27) were other diseases. Environmental influences include deficiency of Iodine, malnutrition, exposure to chemicals, maternal influences, Rh incompatibility were studied with incidence of 4.4 % (n=14), 22.2 % (n=70), 5.4 % (n=17), 7.6 % (n=24), 9.5 % (n=30) respectively. 50.9 % (n=160) have unexplained etiology.

In a study, the causes and associated disorders among children with mental retardation, cerebral palsy represent 7.8 % of cases with mental retardation, unexplained cause represented 70 %, Down syndrome represented 6.7 %, hypothyroidism represent 2.2 %, phenylketonuria represent 3.3 %, brain trauma represent 3.3 %, post-CNS infection cases represent (3.3 %) and MR associated with epilepsy (3.3 %).10 In this study, at the time of birth (perinatal) prematurity, birth trauma, complication in delivery causes were observed with 9.8 % (n=31), 1.3 % (n=4) and 18.1 % (n=57) incidence rate while 70.80 % (n=223) not showed any cause. During neonatal stage 0.6 % (n=2) cases of septicemia and 22.6 % (n=71) cases of jaundice were observed in ID patients. 20.6 % (n=65) have unexplained etiology and 56.2 % (n=177) have no causes. 22.5 % (n=71) with brain infection, 8.6 % (n=27) with head injury, lead exposure with 0.3 % (n=1) and 13.3 % (n=42) with malnutrition causes were calculated at postnatal stage while 55.24 % (n=174) have no cause at this stage. Intellectual disability has a significant association with residency, family history, chromosomal disorder, perinatal, neonatal and postnatal factors while gender, parent consanguinity, gene mutation diseases, and prenatal show non-significance levels. The significant statistical attachment between intellectual disabilities and family's socioeconomic profile in terms of residence, maternal, paternal education, father's job, and parent's consanguinity [10] is relatable with our study. The goal of this study is to give parents of ID patients advice on how to help their children survive in the environment. This research has immediate and long-term consequences for the diagnosis and treatment of ID patients and also advances our scientific understanding of this complicated disorder. Furthermore, it improves our knowledge of the prevalence of certain ID factors.

5. CONCLUSION

Analysis of recent study indicates significant association of intellectual disability with residency, family history, and chromosomal disorder, perinatal, neonatal and postnatal factors while gender, parent consanguinity, gene mutation diseases, and prenatal

shows non-significance level. With the discovery of incidence of predominance and risk factors of ID, it will help to diagnose the disease accurately and this discovery can also help in the couple plan in future.

6. ACKNOWLEDGMENTS

We are thankful to patients and their families for giving data and also thankful to the staff of Institutions and hospitals for their cooperation.

7. CONFLICT OF INTEREST

There is no conflict of interest among coauthors.

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