International Journal of Contemporary Issues in Social Sciences
Volume 3, Issue 3, 2024 ISSN(P):2959-3808 | 2959-2461

STATISTICAL DETERMINANTS OF CEREBRAL PALSY: A CASE STUDY OF KHYBER PAKHTUNKHWA

Neelam[1], Sofia[2], Qamruz Zaman[*3], Nisar Ullah[4], Danish Waseem[5], Raees Khan[6]

[1,3,6]Department of Statistics, University of Peshawar, Pakistan; [2]College of Home Economics, University of Peshawar, Pakistan; [4]Government Degree College, Banda Daud Shah, Karak, Pakistan; [6]Department of Mathematics and Statistics, University of Swat, Swat, Pakistan

[*3]cricsportsresearchgroup@gmail.com

Corresponding authors*

Received: July 20, 2024 **Revised:** August 20, 2024 **Accepted:** July 10, 2024 **Published:** September 20, 2024

ABSTRACT

This study aims to explore the determinants of cerebral palsy in Khyber Pakhtunkhwa using statistical tools. The examines the associated factors involved in cerebral palsy using a standard questionnaire. The second stage uses statistical tools to determine the relationship between these factors and the disease. Data was analyzed using SPSS software version 23.0, with frequency distribution, Pie chart, Bar chart, Histogram, Chi-square test of association, and Odds ratio for strength of association. Data was collected from 223 parents from Akbar Kare Institute, with 182 male and 41 female respondents. The patients were 69 urban and 124 rural. Out of the 223 respondents, 57% were first cousins, 30.5% were second cousins or relatives, and 12.6% were unknown. The results were interpreted using various statistical tools. The ordinal logistic regression model revealed that cerebral palsy in males was less compared to females. The study also showed that females had higher chances of developing the disease in rural areas than males in urban areas. Possible factors not involved in the disease include using homemade medicine during pregnancy, harassment, knowledge about cerebral palsy before birth, and child jaundice. The main aim of the study is achieved, and the researcher recommends further research using advanced statistical tools and models.

Keywords. Cerebral palsy, Ordinal logistic regression, Chi-square test, Gender differences Consanguinity, Urban vs. rural populations, Birth setting, Maternal knowledge

1. INTRODUCTION

Statistics is an interdisciplinary field that involves collecting and analyzing data on specific characteristics to obtain results [1]. It plays a crucial role in modern medicine, biological sciences, and public health by determining the effect of treatments in clinical trials and testing the role of causative factors in health conditions [2]. Statistical tools help identify syndromes or risk factors of underlying ill health, which can be associated with different factors [3]. Risk factors are essential for health decision-making and planning, such as predicting higher rates of deaths in infants from easily curable diseases and preventing complications during labor and premature birth [4]. Cerebral Palsy (CP) is a common lifelong disability, that affects balance and movement [5]. It is caused by abnormal brain development or slow development and varies from person to person. It was first described by orthopedic surgeon Sir William James in 1862 [6].

1.2 CLASSIFICATION OF CEREBRAL PALSY. In 1956, the American Cerebral Palsy Academy classified cerebral palsy into four main categories based on movement disorder, affecting affected brain areas, characterized by stiff muscles, unbalanced movements, coordination issues, and poor balance [7]. Spastic CP affects 80% of people, causing stiffness in legs, arms, and face, causing difficulty in hearing, speech, walking, and vision. Dyskinesia CP patients experience daily or daily muscle tensions, causing difficulty in walking and sitting due to the inability to control their hand, foot, leg, and arm movements. Ataxic cerebral

palsy patients face difficulty in balancing and coordination[8]. They might face difficulty in quick movements like writing or any task that needs balancin[9]. Spastic with dyskinesia cerebral palsy is a type of mixed CP. Some people have more than one CP, which is called mixed cerebral palsy [10].

1.3 LOCATION OF MOVEMENT PROBLEM. Movement problems in children are easily identified due to brain damage, which can cause damage to both sides. Motor skills may also be influenced by various factors. Monoplegia is a rare type of limb-related condition that is closely related to the limb[11]. Premature birth often causes dyslexia, affecting a child's legs and causing difficulty in upper body movement. Hemiplegia, a condition resulting from prenatal brain bleeding, affects one part of the body more than the other, potentially causing the affected hand to be unable to function[12]. Triplexia refers to a condition where a child has three affected limbs. Quadriplegia affects all four limbs, with the legs being more affected than the arms. Children with this type struggle with facial muscle control [13]. Double hemiplegia is a condition that is exclusively associated with the limbs [14].

1.4 PRE-SIGNS OF CP. Cerebral palsy is a condition where a child experiences delays in movement, such as sitting, walking, and standing. It is not a progressive disease but can lead to various health issues, such as hearing difficulty, vision impairment, emotional and behavioral issues, and cognitive disabilities [15]. Cerebral palsy is classified into quadriplegia, diplegia, hemiplegia, spastic tight muscles and stiff joints, dyskinetic, ataxic, and mixed types [16]. The prevalence of cerebral palsy varies globally, with males being more likely to develop the disorder than females. In the USA, it is estimated that 2-5/1000 live births have cerebral palsy, while in Western nations, it is 2-5/1000 live births[17]. The Australian Cerebral Palsy Register Report indicates four groups at higher risk of developing cerebral palsy: males, preterm, multiple births, and low birth weight. Risk factors for cerebral palsy include inter-family marriages, birth asphyxia, maternal infections, premature birth, cesarean section, low birth weight, and preterm labor. Case-control studies have shown that males are at higher risk than females, and preterm births and low birth weight are highly associated with CP [18]. Various studies have investigated the factors responsible for developing cerebral palsy, including birth asphyxia, prematurity and low birth weight, intracranial bleeding, kernicterus, and CNS malformations [19]. A multivariate logistic regression model has been used to compare prenatal, perinatal, and postnatal events in children with and without cerebral palsy, finding a greater prevalence of dyskinetic CP [20].

1.5 SIGNIFICANCE OF THE RESEARCH. The study aims to explore Cerebral Palsy (CP) in Pakistan using ordinal logistic regression to identify risk factors. It aims to develop a model for clinical trials, allowing precise patient classification based on disease severity. The research will aid physicians and policymakers in developing effective policies and strategies for CP control, enhancing care during gestation, labor, and neonatal stages, and planning for the survival and care of CP children.

1.6 AIMS AND OBJECTIVES

1. To classify CP patients into various levels of disease severity using a Flow Chart
2. To study association and strength of association among various risk factors of CP using Chi-Square and Odds Ratio analysis
3. To identify the significant risk factors of CP using the Ordinal Logistic Regression Model

1. LITERATURE REVIEW

Horsefield G [30] reviewed the literature on early services at home for CP children. This survey was about children under five years of age children families and was based on different countries.

Gracy [21] conducted a study on CP children's attitudes and found a significant relationship between age group and attitude, practice, and knowledge among caregivers. A slight change in knowledge can partially influence attitudes and behaviors.

Power et al [22] conducted a study on Bangladesh adolescents with cerebral palsy using the Qualities of Life Teens (CPQoL-Teens) questionnaire, with 145 participants aged 10-18. The questionnaires showed satisfactory feasibility and robust properties, demonstrating the ability to assess HRQL rates among Bangladeshi CP children.

Davies et al [23] compared the conceptual differences using statistical techniques like consistency, and validity for children with PC. Out of 240 caregivers, 185 were females (91%) of CP children below twelve years old.

Van et al [24] investigated the study examined the prevalence and severity of cystic periventricular leukomalacia (CP) among premature survivors in neonatal intensive care units between 1990-2005. The study found a decrease in CP incidence from 6.5% in period I to 2.6%, 2.9%, and 2.2% in period II-IV. The incidence of c-PVL decreased from 3.3% in period I to 1.3% in period IV. Independent risk factors for CP were c-PVL and severe intracranial hemorrhage, while prenatal biotics, blood linage, cesarean section, and gestational age were independent protective factors.

Tsuchiyama et al [25] investigated the study involving 156 pregnancies and 139 women with chronic kidney disease (CKD) and found that children born to mothers with CKD had a higher prevalence of cerebral palsy and mental disability compared to those born to mothers without CKD. The study found that children born to mothers with CKD had a 7.2 times higher risk of developing these conditions compared to those born to mothers without CKD.

Goldsmith et al [26] described CP in a survey of 38 CP surveillance programs that revealed similarities and differences in governance, budget, objectives, scope, definition, inclusion/exclusion criteria, validation, and data collection. The 27 programs, ranging from 25 performance records to two for lack of funds, aimed to improve research collaboration. Despite varied methodologies, all programs showed interest in research collaboration, facilitating data synchronization and collaborative research efforts.

Hwang et al [27] studied involving 100 primary caregivers of children with moderate to severe cerebral palsy (CP) and used the Care Q questionnaire to measure their perceived effort in providing care. The results showed average Care Q scores of 30.6, 42.8, and 45.1 for children with GMFCS III, IV, and V levels, with Cronbach coefficients of 0.90, 0.93, 0.80, and 0.82 respectively.

McCullough et al [28] evaluated The Child Health Questionnaire (CHQ) in children with cerebral palsy (CP) was analyzed using various methods from 1993-2007. 13 articles provided data on 1229 children aged 2-18 years. Three studies reported CHQ reliability, while six provided valid evidence. However, psychometric issues need to be addressed.

Berrin et al [29] tested a model study examining the relationship between pain and fatigue in children with cerebral palsy (CP) and their school performance. Results show an indirect relationship between diagnostic subtypes and school performance, partly mediated by fatigue and pain, suggesting potential modifiable interventions.

Zuurmond et al [30] derived the study examines the impact of caregivers of cerebral palsy (CP) children in rural Bangladesh. The PedsQL questionnaire was administered to caregivers in 135 families with and without CP children. The results showed significant anxiety, stigma, stress, isolation, and lack of time for everyday tasks. The study highlights the vulnerability of families with disabilities in limited resources and emphasizes the need for interventions and empowerment of caregivers and children.

Kamaralzaman et al [31] investigated the study in Malaysia and found that parents of CP children face a significant economic burden, with a total annual cost of RM 29,710.76. This burden is primarily due to direct health costs, development costs, non-health-related costs, and indirect costs. The findings can aid policymakers in providing effective services to these parents.

Parkinson et al [32] determined the study in eight European regions found that self-reported pain in children with cerebral palsy (CP) was prevalent at 60%, while parent-reported pain was 73%. Older children reported more pain, but it wasn't significantly associated with disorder severity. Parental reports showed frequent and severe pain associated with disorder severity, seizures, and parental unemployment. The study recommends doctors consider pain during treatment.

Tseng et al [33] study examines the link between cerebral palsy (CP) and socioeconomic status in Taiwan. It found that boys are 30% more likely to develop CP than girls, and low income is associated with higher prevalence. CP was more prevalent in rural areas and had a mortality rate of 12.2 to 22.7 per 1,000 children. The prevalence of CP was similar to Western countries.

Khan et al [34] developed a study conducted on children with and without physical disabilities (CP) to assess sleep patterns and medical risk factors. A

medical sleep questionnaire was designed and a comparative study was conducted, comparing sleep routines, night behavior, and breathing quality. The study included 28 children with CP and 30 children without CP. The questionnaire's reliability and capacity were evaluated over time.

Keawutan et al [35] conducted A study on physical activities and quality of life in children with cerebral palsy (CP) under 5 years and found that ambulant children had better parent-reported QOL than non-ambulant children. However, HPA was not associated with QOL in children aged 5 years.

Al-Shahri et al [36] discussed the study highlights the significant challenges in managing chronic pulmonary hypertension (CP), focusing on treatment, clinical processes, patient care, and patient quality of life, suggesting a comprehensive approach for better management.

Ahmad et al [37] carried out a study in Swabi, Khyber Pakhtunkhwa, Pakistan, and found that out of 278 children with cerebral palsy, 39.6% were aged nine to ten, with 39.2% having spastic quadriplegia and severe malformations. The prevalence was 1.22 per 1000 live births, with parents of children under 10 interviewed.

Hodg et al [38] assessed the quality study assessed the awareness of female caregivers about the need for eye evaluations for CP children. Data was collected from 36 caregivers, with 41.6% from rural areas and 75% unemployed. The study found a significant relationship between QoL scores, physical activity, and load restrictions. However, 24 caregivers were unaware of eye exams.

Bjorgaas et al [39] revealed A study of 47 CP children found a high prevalence of mental health problems and co-occurrence of symptoms. Screening with SDQ detected these issues but did not predict specific disorders. ADHD is common but difficult to diagnose due to its complexity. Regular follow-up is recommended for mental health services.

Jinming et al [40] carried out a study on mothers of CP children. To explore the attitudes of mothers having CP children to their children, family, and to their own lives and how much CP children affect their homes, especially their mothers. The data were collected through a questionnaire from 36 mothers whose children with CP stayed in CRRC for rehabilitation treatment. The results indicated that CP is 1.5 - 5% in China and the total number of CP children of age 0 - 6 is around 300,000. This group of CP children brings much burden to their families and society. CP effects on children are lifelong. When a child is diagnosed with CP, all aspects of his/her parents begin to change.

Abdullahi [41] conducted a study to educate pregnant women attending antenatal clinics of Murtala Mohammed Specialist Hospital (MMSH) and Muhammad Abdullahi Wase Specialist Hospital (MAWSH) in Nigeria, kano state. Convenient sampling techniques were used in the population of all the pregnant women, 37 respondents were selected to answer the questions about knowledge of cerebral palsy in the first week and then they were educated on CP in the second and third weeks. Low levels of CP condition awareness among pregnant women in Kano, Nigeria were recorded but after educational intervention, their knowledge improved and participants were able to give explanations on the cause, clinical manifestation, preventive measures, and management, therefore the need for educational programs on CP during antenatal periods by the medical professionals or through interactive session among the women.

2. METHODOLOGY

3.1 STUDY DESIGN. This cross-sectional study will be conducted in Peshawar, Khyber Pakhtunkhwa, focusing on patients with cerebral palsy (CP) visiting Akbar Kare Institute (AKI), a nonprofit organization that treats and rehabilitates children with disabilities, including those from Waziristan, Swat, Jalalabad, and Herat.

3.2 DATA SOURCE. The study analyzed the prevalence of Cerebral Palsy in 223 patients from the Akbar Kare Institute in Peshawar using Ordinal Logistic Regression as the appropriate statistical technique. The study targeted Khyber Pakhtunkhwa's Akbar Kare Institute Hayat Abad Peshawar's parents, focusing on their experiences in the field of child psychology. Consecutive sampling is a common technique in clinical trials, involving each consecutive eligible patient, and the study will involve mothers of children with cerebral palsy visiting Akber Care Institute. Mothers with children with cerebral palsy visiting AKI for data collection will be approached, and given written consent, and data will be collected using a self-administered structured questionnaire.

3.3 PIE CHART. A pie chart is a graphic device that divides a circle into sectors with proportional

areas. It's used as an alternative to component bar charts and is effective for showing percentage parts when the whole quantity is 100. To create a pie graph, draw a 360o circle with 3600 pieces, and calculate the corresponding proportions using the formula.

$$\text{angle} = \frac{\text{component part}}{\text{whole part}} \times 360^0$$

Then divide the circle into different sectors by constructing angles at the center utilizing a protector to draw the corresponding radii. Pie charts are useful for qualitative data analysis, but they have limitations due to the potential for too many thin pie pieces and difficulty in comparison. William Playfair is believed to have invented the bar graph, a visual representation of data grouped with a rectangular bar in proportion to the values presented. It uses horizontal or vertical bars to show comparisons between categories, with one axis representing the category and the other displaying the discrete value. For instance, a bar graph can show the change in Android phone usage over time.

3.4 CHI-SQUARE (X^2) TEST. The chi-square distribution is a nonparametric tool used in statistical inference to determine group differences between two categorical variables. It was first obtained in 1876 by F.R. Helmert and used by Karl Pearson in the 1900s. The test compares observed values with expected values, determining if there is a significant relationship between the two variables. It has applications such as a test of independence, goodness of fit, and homogeneity. The chi-square distribution has one parameter, degrees of freedom (d.f), which is the number of independent random variables expressing the chi-square. Contingency tables are used to test two or more variables of classification, with observed frequencies and expected frequencies calculated for each cell.

$$\chi 2 = \sum_{i=1}^{r}\sum_{j=1}^{c} \frac{(oij - eij)^2}{eij}$$

o_{ij} represents the observed frequency of the (jth) cell, e_{ij} represents the expected frequency of the (ijth) cell Where a = Number of exposed cases b = Number of exposed non-cases c = Number of unexposed cases d = Number of unexposed non-cases

The null hypothesis is rejected if the calculated p-value is less than the significance level, indicating a dependent or association between two classification variables.

$$OR = \frac{n(exposed\ cases)/n(unexposed\ cases)}{n(exposed\ non-cases)/n(unexposed\ non-cases)}$$

The ordinal logistic model is a popular technique for dealing with dummy dependent variables, allowing researchers to model phenomena where the response variable is ordinal and generate valuable predictions. Based on McCullagh's methodology, the model uses cumulative probabilities for each category, unlike logistic which considers event probability. A hypothetical example shows that the model is robust in predicting patients with different levels of physical disabilities.

$$link(\gamma_{ij}) = \theta_i - [\beta_1 X_{i1} + \beta_2 X_{i2} \cdots \beta_p X_{ip}]$$

Ordinal logistic regression assumes proportional odds for data. If patients have mild, moderate, or severe disabilities, the logarithms of the odds of answering in specific ways are calculated.

$$for\ moderate, \quad log\frac{p_1}{p_2 + p_3} \qquad for\ severe, \quad log\frac{p_1 + p_2}{p_3}$$

The proportional odds assumption states that the number added to logarithms is constant, tested using the Chi-square test. If satisfied, the Proportional Odd Model (POM) is used, otherwise, the Partial Proportional Odd Model (PPOM) is suggested.

3. ANALYSIS AND RESULTS

4.1 RESPONSE RATE

The data was collected from 223 parents. The complete information is summarized in

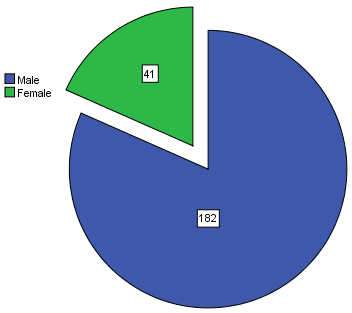
Table 4.1 Complete Information about the Variables of Interest

Variables		Number of Observations	Percentage (%)
Gender	Male	182	81.6
	Female	41	18.4
Area	Rural	153	68.6
	Urban	70	31.4
Type of CP	Severe	136	61.0
	Moderate	59	26.4
	Mild	28	12.6
Visited Doctors	Yes	182	81.6
	No	41	18.4
Harassed During Pregnancy	Yes	193	86.5
	No	30	13.5
Knowledge About CP Before Birth	Yes	212	95.1
	No	11	4.9
Child Weight at the Time of Birth	Yes	182	81.6
	No	41	18.4
Born Before Time	Yes	208	93.3
	No	15	6.7
Child Born at	Home	148	66.4
	Hospital	75	33.6
Child is Cesarean	Yes	181	81.2
	No	42	18.8
Mother Profession	House Wife	197	88.3
	Working	26	11.7
Used Home Made Medicine During Pregnancy	Yes	203	91.0
	No	20	9.0
Father Profession	Jobless	44	19.7
	Daily Wages	112	50.2
	Govt. Servant	21	9.4
	Business	46	20.6
Parents Relationship	First Cousin	127	57.0
	Second Cousin	68	30.5
	Other	28	12.6
Family Type	Extended	54	24.2
	Joint	107	48
	Nuclear	62	27.8
Child Position During Pregnancy	Normal	25	11.2
	Not Normal	74	33.2
	Don't Know	124	55.6
Mother Education	Illiterate	172	77.1

	Literate	51	22.9
Father Education	Illiterate Literate	118 105	52.9 47.1
Child Suffered Jaundice	Yes No	177 46	79.4 20.6
Mother Age	<=18 >18	124 99	55.6 44.4
Father Age	<=18 >18	124 99	55.6 44.4

Data from 223 parents from Akbar Kare Institute Peshawar showed 81.6% male patients and 18.4% female patients, as shown in a pie chart.

Figure: 4. 1 Gender



4.1.2 AREA. Out of 223 patients, 153(68.6%) belonged to rural areas and 70(31.4%) belonged to urban areas as shown in **Figure 4.2.**

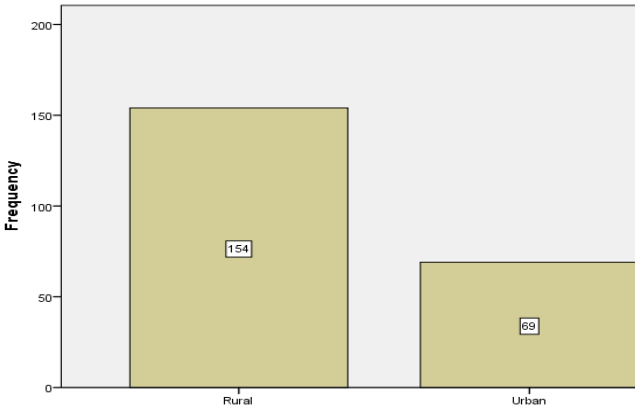


Figure 4. 2: Area

4.3 PARENTS RELATIONSHIP

Table 4.2 revealed that 57% of the patient's parents were first cousins, 30.5% were second cousins or relatives and 12.6% were others.

Table 4. 2: Complete Information about the Parent's Relationship

	Frequency	**Percentage**
First Cousin	127	57
Second Cousin	68	30.5
Others	28	12.6

Out of 223 patients, 81.6% were visited by doctors, while 18.4% were not, as shown in the table. Out of 223 patients, 81.6% knew the child's weight at birth, while 18.4% did not know. Out of 223 patients, 208 (93.3%) knew about birth before time, and 148 (66.4%) were born at home. Out of 223 patients, 181 (81.2%) were born through cesarean section, while 42 (18.8%) were born without cesarean section. Out of 223 mothers, 197 (88.3%) were housewives, and 203 (91.0%) used homemade medicines during pregnancy. Out of 223 fathers, 44 (19.7%) were jobless, while 51 (50.2%) worked on daily wages, 21 (9.4%) as government servants, and 46 (20.6%) as businessmen. Out of 223 families, 54 (24.2%) lived in extended form, 107 (48.0%) in joint form, and 62 (27.8%) in nuclear form. Out of 223 patients, 25 (11.2%) were given birth normally, 74 (33.2%) were given birth abnormally, and 24 (55.6%) were not known about child position during pregnancy. Out of 223 mothers and fathers, 172 (77.1%) were illiterate, and 177 (79.4%) suffered from jaundice.

ASSOCIATION BETWEEN THE TYPE OF CP AND GENDER OF THE CHILD

		Gender of CP Child			Pearson Chi-Square	df	Asymptotic Significance (2-sided)
		Male	Female	Total			
Type of CP	Severe	119	17	136	8.619	2	.013
	Moderate	44	15	59			
	Mild	19	9	28			
Total		182	41	223			

The above table gave a chi-square value of 8.619 and a P-value of 0.013. Comparing the P-value with the predefined α value 0.05 indicates the significant association between the CP and Gender of the affected child.

4.4 Association between the Type of CP and Mother Took Home Made Medicine During Pregnancy.

Table 4.4

		Took Home Made Medicine During Pregnancy			Pearson Chi-Square	df	Asymptotic Significance (2-sided)
		Yes	No	Total			
Type of CP	Severe	128	8	136	10.419	2	.005
	Moderate	54	5	59			
	Mild	21	7	28			
Total		203	20	223			

The above table gave a chi-square value of 10.419 and a P-value of 0.005. Comparing the P-value with the predefined α value 0.05 indicates the significant association between the CP and mother taking the homemade medicines during pregnancy.

4.5 Association between the Type of CP and Family Type

Table 4.5

		Family Type			Total	Pearson Chi-Square	Df	Asymptotic Significance (2-sided)
		Extended	Joint	Nuclear				
Type of CP	Severe	37	74	25	136	16.777	4	.002
	Moderate	12	20	27	59			
	Mild	5	13	10	28			
Total		54	107	62	223			

The above table gave a chi-square value of 16.777 and a P-value of 0.002. Comparing the P-value with the predefined α value 0.05 indicates the significant association between the CP and Family type.

Table 4.6: Relationship between the Type of CP and Area of Residence

		Area of Residence			Pearson Chi-Square	Df	Asymptotic Significance (2-sided)
		Rural	Urban	Total			
Type of CP	Severe	109	27	136	20.126	2	.000
	Moderate	30	29	59			
	Mild	15	13	28			
Total		154	69	223			

The above table gave a chi-square value of 20.126 and a P-value of 0.000. Comparing the P-value with the predefined α value 0.05 indicates the significant association between the CP and the area of the affected child.

Table 4.7 Relationship between the Type of CP and Knowledge about CP before Birth

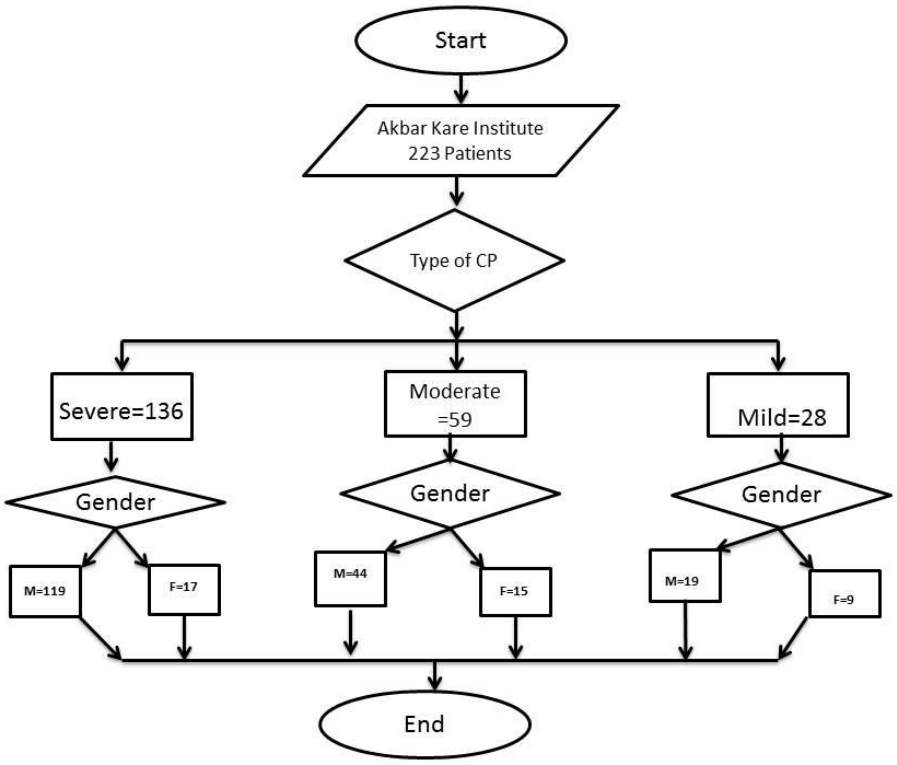
		Knowledge About CP Before Birth			Pearson Chi-Square	df	Asymptotic Significance (2-sided)
		No	Yes	Total			
Type of CP	Severe	135	1	136	64.745	2	.000
	Moderate	59	0	59			
	Mild	18	10	28			
Total		212	11	223			

The above table gave a chi-square value of 64.745 and a P-value of 0.000. Comparing the P-value with the predefined α value 0.05 indicates the significant association between the CP and Knowledge about CP before Birth.

Table 4.8 Odds Ratio between Gender of CP Child * Child Weight at the Time of Birth

		Child Weight at the Time of Birth		Total
		<5.5 pounds	>=5.5 pounds	
Gender of CP Child	Male	151	31	182
	Female	31	10	41
Total		182	41	223
Odds Ratio for Gender of CP Child (Male / Female)				1.571

The above table indicates the odds ratio between the gender of the affected child and low weight at the time of birth. The odds of a low-weight born male baby are 1.571 than the low weight female baby. The Akbar Kare Institute Peshawar collected data from 223 patients, with 136 severe, 59 moderate, and 28 mild cases of CP. The study found that males had a higher CP ratio than females. The data was presented in a flowchart, revealing a higher prevalence of CP in males. The Akbar Kare Institute Peshawar collected data from 223 patients, with 136 severe, 59 moderate, and 28 mild patients. The study found that the ratio of CP is higher in rural areas compared to urban areas. Out of 136 severe patients, 109 were from rural areas, 59 from rural areas, and 15 from urban areas. The data was categorized gender-wise and presented in a flowchart.



4.9 ORDINAL LOGISTIC REGRESSION MODEL

Ordinal Logistic Regression Model for Overall Satisfaction

		Estimate	Std. Error	Wald	df	Sig.	Exp(β)
Location	[G=1]	-1.475	.496	8.846	1	.003	0.2287787
	[M=1]	-.304	.705	.187	1	.666	0.7378609
	[D=1]	-.999	.561	3.165	1	.075	0.3682475
	[D=2]	0[a]	.	.	0	.	
	[V=1]	-.881	.520	2.870	1	.090	0.4143683
	[V=2]	0[a]	.	.	0	.	
	[B=1]	-.783	.676	1.341	1	.247	0.4570329
	[B=2]	0[a]	.	.	0	.	
	[H=1]	-1.659	.545	9.261	1	.002	0.1903292
	[H=2]	0[a]	.	.	0	.	
	[A=1]	-1.880	.656	8.215	1	.004	0.1525901
	[A=2]	0[a]	.	.	0	.	
	[F_P=1]	-.154	.657	.055	1	.815	0.857272
	[F_P =2]	.039	.525	.006	1	.940	1.03977
	[FProf=3]	.310	.726	.182	1	.669	1.363425
	[FProf=4]	0[a]	.	.	0	.	
	[M_P=1]	-1.938	.572	11.468	1	.001	0.1439916
	[M_P =2]	0[a]	.	.	0	.	

	[C=1]	-1.544	.557	7.674	1	.006	0.2135253
	[C=2]	0[a]	.	.	0	.	
	[K=1]	-4.896	1.156	17.946	1	.000	0.00747642 9
	[K=2]	0[a]	.	.	0	.	
	[W=1]	-1.503	.490	9.417	1	.002	0.2224618
	[W =2]	0[a]	.	.	0	.	
	[P_R=1]	1.593	.998	2.546	1	.111	4.918482
	[P_R =2]	.802	.645	1.544	1	.214	2.229996
	[P_R =3]	0[a]	.	.	0	.	
	[F_T=1]	-.665	.629	1.117	1	.291	0.5142735
	[F_T =2]	-.766	.542	1.995	1	.158	0.4648688
	[F_T =3]	0[a]	.	.	0	.	
	[C_P=0]	1.177	.719	2.680	1	.102	3.244626
	[C_P =1]	-.050	.672	.005	1	.941	0.9512294
	[C_P =2]	0[a]	.	.	0	.	
	[M_E=1]	-.255	.532	.230	1	.631	0.7749165
	[M_E =2]	0[a]	.	.	0	.	
	[F_E=1]	-.852	.447	3.629	1	.057	0.7749165
	[F_E =2]	0[a]	.	.	0	.	
	[J=1]	-2.184	.475	21.139	1	.000	0.1125903
	[J =2]	0[a]	.	.	0	.	
	[M_A=1]	.073	.655	.012	1	.912	1.075731
	[M_A =2]	0[a]	.	.	0	.	
	[F_A=1]	-.058	.508	.013	1	.908	0.9436499
	[F_A =2]	0[a]	.	.	0	.	
	[A_D=1]	-.695	.634	1.205	1	.272	0.4990744
	[A_D =2]	-1.000	.568	3.097	1	.078	0.3678794
	[A_D =3]	0[a]	.	.	0	.	
	[S=1]	1.526	.739	4.257	1	.039	4.599741
	[S=2]	0[a]	.	.	0	.	
	[P_P=1]	.763	.746	1.044	1	.307	2.144701
	[P_P =2]	0[a]	.	.	0	.	

*****p< 0.05 shows significant level. For gender, the odds of Cerebral Palsy in males were 0.2287 times less as compared to females. For homemade medicine during pregnancy, those who used homemade medicine during pregnancy had 0.7378 times less chance of having Cerebral Palsy as compared to those who did not use the homemade medicine during pregnancy. For harassed during pregnancy, those who were harassed during pregnancy had 0.1903 times less chance of having Cerebral Palsy as compared to those who were not harassed during pregnancy. For area, those who lived in rural areas had 0.1525 times less chance of having Cerebral Palsy as compared to those who lived in urban areas. For the mother profession, housewives had 0.1439 times fewer chances of having Cerebral Palsy as compared to those who were working. For knowledge about CP before birth, those who knew CP before birth had 0.0074 times less chance of having Cerebral Palsy as compared to those who did not know CP before birth. For child weight at the time of birth, those who knew the child's weight at the time of birth had 0.2224 times less chance of having Cerebral Palsy as compared to those who did not know the child's weight at the time of birth. For child suffered jaundice, those who had a child who suffered jaundice had 0.1125 times less chance of having Cerebral Palsy as compared to those who had no child suffered jaundice. The details of the fitted

ordinal logit model are provided in Table 4.3. The extent of CP was measured on the significance of twenty-three independent variables. P values were compared with the 0.05 level of significance. The smaller the value indicated the significance of the variables. Odds Ratios were used to find the strength of the independent variables.

4.10 ANALYSIS OF ORDINAL LOGISTIC REGRESSION MODEL FOR RURAL

Table 4.10 Summary of Model Fit for Rural Area

Model	-2 Log Likelihood	Chi-Square	Df	Sig.
Intercept Only	241.968			
Final	98.698	143.270	28	.000

Table 4.9 indicates a significant Chi-square statistic ($p < 0.05$) implying that the logit model gives a significant improvement over the baseline intercepts-only model. It suggests that the model gives better predictions

Table 4. 11 Interpretation of Ordinal Logistic Regression Model for Rural

		Estimate	Std. Error	Wald	df	Sig.	Exp(β)
Location	[G=1]	-2.572	1.008	6.513	1	.011	0.07638263
	[G=2]	0[a]	.	.	0	.	
	[M=1]	-.343	1.359	.064	1	.801	0.7096382
	[M=2]	0[a]	.	.	0	.	
	[D=1]	-.792	1.014	.611	1	.435	0.452938
	[D=2]	0[a]	.	.	0	.	
	[V=1]	-2.466	.949	6.755	1	.009	0.08492388
	[V=2]	0[a]	.	.	0	.	
	[B=1]	-1.516	1.025	2.188	1	.139	0.2195885
	[B=2]	0[a]	.	.	0	.	
	[H=1]	-2.591	.988	6.874	1	.009	0.07494506
	[H=2]	0[a]	.	.	0	.	
	[F_P =1]	-.231	1.066	.047	1	.829	0.7937395
	[F_P =2]	-.202	.887	.052	1	.820	0.8170949
	[F_P =3]	.741	1.327	.312	1	.576	2.098032
	[F_P =4]	0[a]	.	.	0	.	
	[M_P =1]	-2.874	1.099	6.842	1	.009	0.05647258
	[M_P =2]	0[a]	.	.	0	.	
	[C=1]	-1.486	1.168	1.618	1	.203	0.226276
	[C=2]	0[a]	.	.	0	.	
	[K=1]	-5.234	1.690	9.596	1	.002	0.005332154
	[K=2]	0[a]	.	.	0	.	
	[W=1]	-2.696	.828	10.608	1	.001	0.06747487
	[W=2]	0[a]	.	.	0	.	
	[P_R =1]	25.029	1.174	454.658	1	.000	74123614301
	[P_R =2]	23.321	.000	.	1	.	13433265935
	[P_R =3]	0[a]	.	.	0	.	
	[F_T =1]	-1.430	1.089	1.726	1	.189	0.2393089

	[F_T =2]	-1.343	.936	2.057	1	.152	0.2610613
	[F_T =3]	0[a]	.	.	0	.	
	[C_P =0]	2.147	1.312	2.675	1	.102	8.559142
	[C_P =1]	1.631	1.288	1.604	1	.205	5.108981
	[C_P =2]	0[a]	.	.	0	.	
	[M_E =1]	-2.018	1.094	3.403	1	.065	0.132921
	[M_E =2]	0[a]	.	.	0	.	
	[F_E =1]	-1.304	.803	2.634	1	.105	0.2714438
	[F_E =2]	0[a]	.	.	0	.	
	[J=1]	-3.164	.759	17.364	1	.000	0.04225638
	[J =2]	0[a]	.	.	0	.	
	[M_A=1]	-.230	1.177	.038	1	.845	0.7945336
	[M_A =2]	0[a]	.	.	0	.	
	[F_A=1]	2.161	.992	4.742	1	.029	8.679813
	[F_A =2]	0[a]	.	.	0	.	
	[A_D=1]	-.508	1.001	.258	1	.612	0.6016978
	[A_D =2]	-1.128	.948	1.415	1	.234	0.32368
	[A_D =3]	0[a]	.	.	0	.	
	[S=1]	3.141	1.486	4.470	1	.035	23.12698
	[S=2]	0[a]	.	.	0	.	
	[P_P=1]	.467	1.187	.155	1	.694	1.595201
	[P_P =2]	0[a]	.	.	0	.	

**p*< 0.05 shows significant level. For gender in rural areas, the odds of Cerebral Palsy in males were 0.0763 times less as compared to females. For child position during pregnancy in rural areas, those who have normal child position during pregnancy had 0.0849 times less chance of having Cerebral Palsy as compared to those who were not in normal child position during pregnancy. For harassment during pregnancy in rural areas, those who were harassed during pregnancy had 0.0749 times less chance of having Cerebral Palsy as compared to those who were not harassed during pregnancy. For the mother profession in rural areas, housewives had 0.0564 times less chance of having Cerebral Palsy as compared to those who were working. For knowledge about CP before birth in rural areas, those who knew CP before birth had 0.0053 times less chance of having Cerebral Palsy as compared to those who did not know CP before birth. For child weight at the time of birth in rural areas, those who knew the child's weight at the time of birth had 0.674 times less chance of having Cerebral Palsy as compared to those who did not know the child's weight at the time of birth. For parent relationships in rural areas, those whose parents were first cousins and second cousins had more chances of having Cerebral Palsy as compared to the reference category. For children who suffered jaundice in rural areas, those who had a child who suffered jaundice had 0.0422 times less chance of having Cerebral Palsy as compared to those who had no child who suffered jaundice. For father age in rural areas, those whose father age was eighteen or less than eighteen were 8.6798 more times the chances of having Cerebral Palsy as compared to those whose father age was above eighteen.

Table 4.12 Interpretation of Ordinal Logistic Regression Model for Urban

		Estimate	Std. Error	Wald	Df	Sig.	Exp(β)
Location	[G=1]	-1.246	.474	6.900	1	.009	0.2876531
	[G=2]	0[a]	.	.	0	.	

	[M=1]	-.205	.673	.093	1	.761	0.8146473
	[M =2]	0[a]	.	.	0	.	
	[D=1]	-1.073	.539	3.960	1	.047	0.341981
	[D=2]	0[a]	.	.	0	.	
	[V=1]	-.898	.502	3.198	1	.074	0.4073836
	[V=2]	0[a]	.	.	0	.	
	[B=1]	-.931	.662	1.978	1	.160	0.3941594
	[B=2]	0[a]	.	.	0	.	
	[H=1]	-1.637	.536	9.311	1	.002	0.1945629
	[H=2]	0[a]	.	.	0	.	
	[F_P=1]	.046	.641	.005	1	.942	1.047074
	[F_P =2]	.158	.506	.097	1	.755	1.171166
	[F_P =3]	.579	.713	.659	1	.417	1.784253
	[F_P =4]	0[a]	.	.	0	.	
	[M_P=1]	-1.859	.560	11.015	1	.001	0.1558284
	[M_P =2]	0[a]	.	.	0	.	
	[C=1]	-1.462	.543	7.257	1	.007	0.2317723
	[C=2]	0[a]	.	.	0	.	
	[K=1]	-4.795	1.157	17.163	1	.000	0.008270999
	[K=2]	0[a]	.	.	0	.	
	[W=1]	-1.619	.482	11.277	1	.001	0.1980967
	[W=2]	0[a]	.	.	0	.	
	[P_R=1]	.233	.853	.075	1	.784	1.262381
	[P_R =2]	.540	.627	.742	1	.389	1.716007
	[P_R =3]	0[a]	.	.	0	.	
	[F_T=1]	-1.022	.590	2.999	1	.083	0.3598745
	[F_T =2]	-.925	.514	3.237	1	.072	0.3965314
	[F_T =3]	0[a]	.	.	0	.	
	[C=0]	1.075	.690	2.423	1	.120	2.929993
	[C=1]	-.069	.655	.011	1	.916	0.9333267
	[C=2]	0[a]	.	.	0	.	
	[M_E=1]	-.336	.523	.414	1	.520	0.7146231
	[M_E =2]	0[a]	.	.	0	.	
	[F_E=1]	-.597	.430	1.923	1	.166	0.5504605
	[F_E =2]	0[a]	.	.	0	.	
	[J=1]	-1.861	.454	16.782	1	.000	0.155517
	[J=2]	0[a]	.	.	0	.	
	[MA=1]	-.099	.633	.024	1	.876	0.9057427
	[MA =2]	0[a]	.	.	0	.	
	[F_A=1]	.013	.485	.001	1	.979	1.013085
	[F_A =2]	0[a]	.	.	0	.	
	[A_D=1]	-1.045	.604	2.997	1	.083	0.3516918
	[A_D =2]	-1.243	.550	5.114	1	.024	0.2885174
	[A_D =3]	0[a]	.	.	0	.	
	[S=1]	1.138	.703	2.619	1	.106	3.120521
	[S=2]	0[a]	.	.	0	.	
	[P_P=1]	.483	.714	.458	1	.499	1.62093
	[P_P =2]	0[a]	.	.	0	.	

*****p< 0.05 shows significant level. For gender in urban areas, the odds of Cerebral Palsy in males were 0.2876 times less as compared to females. For children born in urban areas, those who were born at home had 0.3419 times less chance of having Cerebral Palsy as compared to those who were born in a hospital. For harassment during pregnancy in urban areas, those who were harassed during pregnancy had 0.1945 times less chances of having Cerebral Palsy as compared to those who were not harassed during pregnancy. For mothers profession in urban areas, housewives had 0.1558 times less chance of having Cerebral Palsy as compared to those who were working. For children in cesarean in urban areas, those whose child born in cesarean cases had 0.2317 times less chance of having Cerebral Palsy as compared to those whose children were not born in cesarean cases. For knowledge about CP before birth in urban areas, those who knew CP before birth had 0.0082 times less chance of having Cerebral Palsy as compared to those who did not know CP before birth. For child weight at the time of birth in urban areas, those who knew the child's weight at the time of birth had 0.1980 times less chances of having Cerebral Palsy as compared to those who did not know the child's weight at the time of birth. For child suffered from jaundice in urban areas, those who had a child who suffered from jaundice had 0.155 times less chance of having Cerebral Palsy as compared to those who had no child who suffered from jaundice.

4. CONCLUSION

This study aimed to examine the factors involved in cerebral palsy and test statistical applications. Data was collected from 223 parents from Akbar Kare Institute, with 182 male and 41 female respondents. The patients were 69 urban and 124 rural. Out of the 223 respondents, 57% were first cousins, 30.5% second cousins or relatives, and 12.6% unknown.

Statistical tools such as ordinal logistic regression and chi-square test were used to determine the relationship between associated factors and disease. Results showed that the chances of cerebral palsy were less in males compared to females, and those who were harassed during pregnancy had a lower chance of developing the disease. In rural areas, working women had more chances of having the disease compared to housewives. Those who knew about cerebral palsy before birth had a 0.0074 times lower chance of developing the disease. In urban areas, the chances of the disease were higher in females than males. Children born in hospitals were at a higher risk of cerebral palsy compared to those born at home. Housewives and those who knew about cerebral palsy before birth were less likely to have the disease. In urban areas, those who had children suffering from jaundice had a 0.155 times lower chance of developing cerebral palsy compared to those who did not. In cesarean cases, respondents had less chance of developing cerebral palsy.

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