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RESEARCH PAPER

Care-Chronicles: Prevalence and Socio-cultural Spectrum of Fetal Brain Development Defects in Punjab, Pakistan

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ABSTRACT

Fetal brain development defects like spina bifida and Hydrocephalus, a worse outcome of maternal malnutrition is a significant public health concern globally, which leads to child morbidity and mortality consequently. The Present study explores the intricate landscape of fetal brain development defects and aims to foster deeper understanding of the role of socio-economic dynamics and cultural practices for shaping poor maternal health and nutritional practices outcomes. Applying Quantitative research in province of Punjab, Pakistan. Multistage sampling was used for conducting in-person surveys at public children hospitals in randomly selected districts. Whereas, purposive sampling technique selected for approaching 450 mothers as study respondents who have at least one child with Neural Tube defect (HCP & SB). Major findings highlighted association of socio-cultural factors as: Household income, type of marriage, education level of respondent, women autonomy, place of residence and maternal health seeking behavior regarding nutritional practices. Elimination of poverty, enhancing female autonomy and literacy, campaigns for Mass awareness, promoting the use of fortified food & supplements as preventive measures are recommended.

KEYWORDS: Dietary Supplements, Maternal Malnutrition, Neural Tube Defect

Introduction

According to Allen and Martinez (2005), children represent the future human capital of a country, making their health a crucial component for the nation's development (Government of Pakistan, 2020). its considered to be inevitable exploring the causes of children health disparities, as those with poor health are at greater risk (Victorino & Gauthier, 2009). In recent decades, social determinants of health, such as family structure, socioeconomic status, and race/ethnicity, have gained significant attention as predictors of a child's health (Wu et al., 2019) and have contributed to shaping desired health policies (Siegler & Epstein, 2003).Children are more vulnerable than adults, and their health is negatively impacted by their household's poor economic status, which can lead to lack of knowledge, malnutrition, insufficient access to healthcare, and unsanitary conditions. Poor child health can result in morbidity (Mahmood et al., 1995).

Birth Defects: A Global Health Challenge

Worldwide, birth defects (BD) such as neural tube defects (NTDs) are prevalent, but the prevalance of serious BD have been observed at the time of birth is nine out of ten children in low- and middle-income countries (World Health Organization, 2023). In contrast,USA is facing almost 3000 pregnancies annualy affected with NTDs (Center for Disease Control, 2020). The province of Shanxi, located somewhere in coal mining area

of the Northern China, got reported as at the top of NTDs prevalance worldwide at the time of birth. Factors related to the mother that are significantly linked with vulnerability of NTDs include aquiring only primary school education, lower socioeconomic status, repeatation of giving birth to another NTD affected child and dietary factors during pregnancy (Zhiwen et al., 2020).

Neural Tube Defects: A Least Talked Debate in Pakistan

In 2021, Pakistan still faces high infant mortality and under-five mortality rates, with 57 deaths and 65.2 deaths per thousand live births, respectively, indicating a significant gap from the SDGs target (National Institute of Population Studies, 2018). Multiple studies conducted in Pakistan suggest that a notable proportion of pediatric patients visiting public hospitals have at least one birth defect, with the nervous and urogenital systems being the most commonly affected.

Social Determinants of Neural Tube Defects

The primary determinants influencing the occurrence of birth defects in Pakistan include maternal, socioeconomic, nutritional, and educational factors. Among these factors, socioeconomic status (SES) plays a crucial role with respect to the health of child, directly linked to household income. Children and mothers from poor backgrounds face many a health challenges and outcomes compared to those from rich backgrounds who afford high-quality food and hygiene services (Séguin et al., 2015).

Consanguineous marriage, which is common in Pakistan, also plays a significant role in birth defects (Kanaan et al., 2008). Education is another essential factor in reducing child health issues, more so than income. Mothers with higher education possess more information and awareness of child health, including periconceptual supplementation with folate (Pawlinska & Wronka, 2007). The education level of both parents is linked with illnesses, deprived nutrition in mothers and children, and the father's financial strength and provision of necessary health facilities (Mondal et al., 2009). Maternal occupation has also been implicated in the incidence of birth defects (Mumtaz et al., 2015). Women's service status affects their control upon the salary they earn and ability for to utilize child as well as maternal health care services. However, in rural areas, cultural norms often prevent women from working outside their home(Fawole & Adeoye, 2015).

The health of a mother during pregnancy is crucial, as exposure to disease or malnutrition of mothers can increase the risk of health issues or mortality for the child (Santrock, 2013). Additionally, the occurrence of birth defects is more common in males than females (Shaw et al., 2003).Access to mass media influence significantly on improving health outcomes of mother and child.Television programs provide information on maternal and child health, nutrition, vaccination, and healthcare facilities, empowering mothers to better care for themselves and their children (Bennett, 2017).

Present study is going to explore the incidence of NTDs, also the nature and extent to which socio-cultural determinents affect maternal health and fetal brain development defects.

Hypotheses

1 Lower the family-income of respondent, Higher will be the prevalence of fetal brain development defect

2 Higher the trend of cousin marriages, higher will be the prevalence of fetal brain development defects

3 Lower the education level of respondent, higher will be the prevalence of fetal brain development defects

4 Lower the education level of respondent's husband, higher will be the prevalence of fetal brain Development defects

5 Higher the settlement in rural areas, higher will be the prevalence of fetal brain Development defects

6 Lower the maternal health seeking behaviour, higher will be the prevalence of fetal brain Development defects

Conceptual Framework

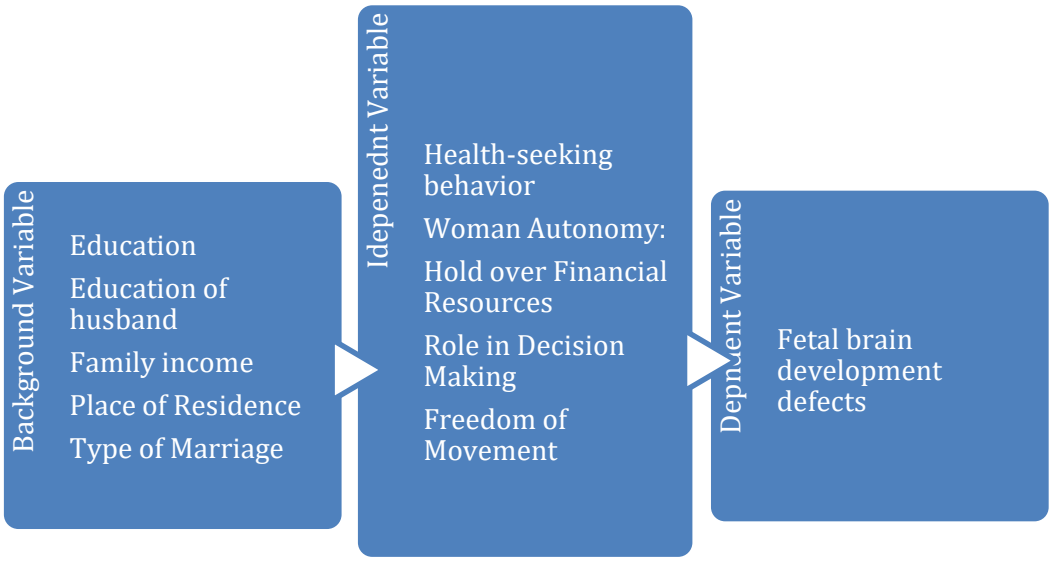

Figure 1: Conceptual Framework of the Study

Literature Review

Banerjee et al. (2005) regards the era of pregnancy till the completion of first eight years of a child's life, as the most critical stage of human life due to the rapid development of the brain. And micronutrient deficiency can cause serious health problems for both the fetus and the mother, including premature birth, mental retardation, and fetal impairments. Bliss et al. (2016) found that 88% of neural tube defects are prenatally diagnosed in Europe.

UNICEF (2017) reported that nearly 20 million children worldwide suffer from severe acute malnutrition, causing half of childhood mortality and one-third of SAM-related deaths. Gross and Webb (2006) found that 78% of wasted children are from Pakistan, Bangladesh, and India, and poor nutrition status during pregnancy is associated with about one-third of child mortality in Pakistan,

Ali et al. (2021) concluded that taking folic acid daily, both before and during pregnancy, is an effective measure for reducing the risk of fetal brain development defects. Agampodi et al. (2021) conducted a systematic review and meta-analysis of the period prevalence of spina bifida by folic acid fortification status, geographic region, and study population. The study found that spina bifida is significantly more common in regions without mandatory folic acid fortification legislation (i.e., Asia, Europe), and that

mandatory fortification resulted in a lower prevalence of spina bifida regardless of birth cohort. Birth defects remain a significant source of morbidity and mortality worldwide.

Mcgregor et al. (2007) argue that various factors can affect a child's health and development, such as parental education, maternal health, malnutrition, exposure to environmental toxins, ethnicity, family environment, quality of child care, parent-child interactions, socio-cultural context, biological factors, and intergenerational transmission of poverty.

World Bank (2016) reported that every sixth person in Pakistan lives in poverty . Baggio et al. (2021) found that poverty limits access to basic social determinants of health such as potable water, housing, and hygienic waste disposal.

Chary et al. (2013) noted that underdevelopment, stigma, and discrimination, combined with insufficient public healthcare systems, lead to poorer health outcomes for rural poor and marginalized households. Mohmand and Gazdar (2007) stated that development programs in South Asia have failed to address inequalities based on caste, gender, and class, leading to maternal and child health disparities.

According to the National Population Commission (2013), there is a low level of formal education among females, which leads to poor skills to compete for any means of livelihood in their environment. The recent National Demographic and Health Survey in Nigeria found that households with a low level of education are among the poorest.

Sandy (2010) identified a lack of information about medical aid and cultural perception of illness that influences health-seeking behavior as barriers to healthcare access. Akhtar et al. (2022) observed low social support and poor understanding of the health system as factors of inequitable access to healthcare services.

Panezai (2019) also highlights the role of cultural factors in reducing accessibility to health facilities, which restricts women's travel to health facilities due to local cultural norms.The World Bank (2019) reports that despite advances in science globally, many developing countries still adhere to certain beliefs and cultural norms that affect healthcare decisions, especially for those with low social and economic status.

Klein and Nestvogel (1992) found that in Pakistan, socio-cultural values, norms, and severe cultural inequality impact the status of women in society. Baig et al. (2018) identified that while the status of women in urban areas of the country is comparatively better, feudal systems still exist in most rural areas where cultural customs take precedence.

Malhotra (2005) emphasizes that empowerment is critical for both genders, but it is particularly crucial for women, given their deprived status in society. Joshi et al. (2016) conclude that women's empowerment enables them to have their own intellectual and material resources for self-supportive and self-governing status.

Rainey et al. (2011) describes the multiple determinants of health inequities in Pakistan, such as the availability of health services, access to schooling, levels of health literacy, workforce participation, and social connections, all against the backdrop of socio-economic deprivation and gender norms that disadvantage women

Material and Methods

Research Design

The present research was quantitative and descriptive in nature. Which was conducted in the province of Punjab, Pakistan. Being largest and most populous province of country.

Sampling

The multistage sampling technique was used in this study to find out the nature and the extent of the influence of socio-cultural determinents on prevalance of fetal brain development defects in pakistan. At 1st stage, three districts Lahore, Faisalabad and Multan were selected randomly from central Punjab. Study was conducted in public hospitals so on 2nd stage three public hospitals for children in those selected districts were chosen respectively and at 3rd stage respondents were approached.

Sample Size and Inclusion Criteria

150married mothers aged between 15 to 49years who have at least one child under the age of 5 affected with brain development defect in each hospital thus making a total sample size of 450 respondents were selected as our respondents through purposive sampling technique. The used techniques helped the researcher to gather information within less time and little resources.

Research Instrument and Quantifying Scale

A structured questionnaire by the help of study objectives and existing literature was developed using 3 & 5 point Likert scale and used in Conducting in-person surveys at hospital OPD to approach respondents for data collection.

Pre-testing

The researcher herself conducted the pre-test in a selected public children's hospital. Thirty individuals were interviewed, with the assistance of health specialists (Neurosurgeons), and their suggestions and recommendations were taken into consideration. Any necessary changes were made to the research tool in consultation with the supervisor.

Validity and Reliability

Cronbach's Alpha was used to determine the internal consistency reliability of the results across items. The maternal autonomy scale consisted of four variables, and the Cronbach's Alpha value was 0.733. The respondent level of awareness was measured through literacy level as the biggest socio-economic barrier, which consisted of two variables, and the value of Cronbach's alpha was 0.734. All other variables also showed high values of Cronbach's alpha, indicating that all the scales used in the study were highly reliable . Before data collection, the experts including research supervisor (Associate Professor at department of Sociology, UOS) and Neurosurgeon at Children's Hospital Faisalabad, To ensure the validity of research instruments had a meeting, reviewed the instruments and recommended possible changes to improve the content and face validity.

Data Analysis

The data was analyzed through statistical software of data analysis (SPSS) for uni-variate , Bi-variate and Multi-variate analysis respectively, using statistical techniques i.e., descriptive statistics i.e., frequencies, percentages, mean and Std. deviation values to analyze the data. For hypothesis testing and checking the association

and effects Chi-Square Test, Gamma statistics, ANOVA and logistic regression were applied.

Ethical Considerations

The study was approved by the departmental board of studies and the university's ethical committee after reviewing the research proposal. The research was further approved by the Advanced Studies Research Board of the University of Sargodha. The researcher obtained prior approval for data collection from all selected institutions through proper channels (Children's Hospitals in Faisalabad, Lahore, and Multan) by obtaining letters from the Medical Superintendents of the respective hospitals. The researcher discussed the data collection tools with various officials and concerned authorities at the institutions, including the Additional Director of The School of Allied Health Sciences (a member of the Ethical Research Board of CH-Lahore), Assistant Medical Superintendents, and Neurosurgeons (CH-Multan & Faisalabad).

The researcher obtained consent from all the participants before conducting interviews. Before starting the interviews, the study's objectives and rationale were thoroughly discussed, and any questions or concerns the participants had been addressed. The consent form explicitly stated the objectives and aims of the study, along with a promise of strict confidentiality for the participants. Due to cultural sensitivity and the need for comfortable communication with women, the researcher herself conducted the interviews with the mothers. The participants felt comfortable participating in the discussion with the researcher due to the comfortable mode of communication, clarity of the instrument, and referrals by doctors

Results and Discussion

For rational discussion and coherent explanation of findings, it is necessary to have understandings regarding the respondent's socio-demographic profile. Table 1 presented demographic distribution of characteristics and results indicated that out of total 450 respondents, A significant proportion (71.6%) of the participants were under 20years of age when got married, half (50.2%) of the sampled mothers were illiterate .very least portion like 2.4% belonged to working class, doing jobs. one-fourth (25.6%) of the participants belonged to nuclear family structure. About 63% of the participants had family income around fifteen thousand. Where as majority (57.8%) of the sampled mothers reported that their male child is affected.

Table 1
Distribution of demographic characteristic

Demographic Variables	N	%
Age (at marriage)		
Upto 20	322	71.6
21-30	125	27.8
31-40	03	0.7
Education		
Ilitterate	226	50.2
Primary	48	10.7
Middle	90	20.0
Matric and Above	86	19.1
Family Type		
Joint	335	74.4
Nuclear	115	25.6
Occupational Status		
House Wife	439	97.6

Working woman	11	2.4
Family Income		
Upto 15000	283	62.9
16000-30000	66	14.7
31000 and above	101	22.4
Gender (affected baby)		
Male	260	57.8
Female	190	42.2

The accumulative level of agreement were calculated and presented in table 2 , which helps researchers to understand the extent of agreement reported by participants and found the frequency distribution along with mean responses against the different causes of fetal brain development defects such as The mean value of respondent's perception about lacking the use of FA and multivitamins to be the main cause behind birth defect of their child is 1.93 and Std. deviation is 0.81 which are significantly higher and different from all other causes . The mean of Poor nutrition during reproductive age is 1.82 and cousin marriage is 1.81, while Std. Deviation is .88 and .78 respectively, which are slighttly different from each other, but the mean value of lack of antenatal check ups is 1.76 and its Std. Deviation is .67. The mean and Std. Deviation of Ignorance is 1.25 and .64; which are significantly different from the mean of Improper guidance by doctor which is 1.08 and std. Deviation is .92.

Table 2
Mean and Standard Deviation of mother's perception about causes of fetal brain development defect

Causes	Not at all (1)		To some extent (2)		To great extent (3)		Mean	S.D.	Rank
	f	%	*f*	%	*f*	%			
Lack of use of folic acid and multivitamins	145	32.2	192	42.7	113	25.1	1.93	.81	1
Poor nutrition during reproductive age	176	39.1	177	39.3	97	21.6	1.82	.78	2
Cousin marriage	145	32.2	244	54.2	61	13.6	1.81	.88	3
Lack of antenatal checkup	222	49.3	114	25.3	114	25.3	1.76	.67	4
Ignorance	380	84.4	29	6.4	41	9.1	1.25	.64	5
Improper guidance by doctor	424	94.2	16	3.6	10	2.2	1.08	.92	6

The table 3 found the frequency distribution along with mean responses against the different participants' views about the most effective method to eradicate micronutrient maternal malnourishment in our country and fetal brain development defects. In the light of respondents' views, the Surgery/treatment cost of affected babies for needy families should be eliminated (4.68±.47) was ranked most affective method. The mean value of this method fell in between agree and strongly agree responses, but tending more towards 'strongly agree' response. However, counseling of husbands/mothers in law for Awareness of nutritional deficiencies/outcomes and importance of balanced diet / ANC (4.65±.58), and Midwives/LHV Intervention for maternal counseling about balanced diet and supplements (4.61±.66) were ranked as 2nd and 3rd , respectively. The mean values of these methods fell in between agree and strongly agree responses but close towards 'strongly agree' response.

Table 3
Mean and Standard Deviation of mother's perception about the most effective method to eradicate micronutrient maternal malnourishment and fetal brain development defects

Most effective methods	1		2		3		4		5		M	S.D.	Rank
	f	%	*f*	%	*f*	%	*f*	%	*f*	%			
Counseling to ladies regarding fortified flour and edible oils	0	0.0	8	1.8	5	1.1	252	56.0	185	41.1	4.36	.60	6
Counseling to family heads regarding fortified flour and edible oils	0	0.0	4	0.9	0	0.0	195	43.3	251	55.8	4.54	.55	4
Counselling of husbands/mothers in law for Awareness of nutritional deficiencies/outcomes and importance of balanced diet / ANC	0	0.0	8	1.8	0	0.0	135	30.0	307	68.2	4.65	.58	2
Improving the quality of maternal counselling	0	0.0	40	8.9	0	0.0	286	63.6	124	27.6	4.10	.79	7
Giving reminder messages	0	0.0	74	16.4	4	0.9	229	50.9	143	31.8	3.98	.99	8
Provision of free suppliments at the door step	0	0.0	20	4.4	2	0.4	204	45.3	224	49.8	4.41	.72	5
Midwives/LHV Intervention for maternal counselling about balanced diet and supplements	0	0.0	12	2.7	7	1.6	125	27.8	306	68.0	4.61	.66	3
Surgery/treatment cost of afftected babies for needy families should be eliminated	0	0.0	0	0.0	0	0.0	143	31.8	307	68.2	4.68	.47	1
Involvement of social influencers (religious scholars, actors, leaders,) for awareness about this issue	0	0.0	137	30.4	0	0.0	225	50.0	88	19.6	3.59	1.2	9

Bivariate Analysis

Hypothesis testing results with respect to Prevalence Level of Fetal Brain Development Defect (H1-H6)

The H1 ,H2 ,H3 are presented in the table No.4,5, 6 respectively and chi-square test was applied to determine the relationship between family income and prevalence level of Fetal brain development defects. Statistics ($\chi 2$) displays a significant ($\chi 2$ = 10.04, p = .050) association among the participants' household income and prevalence level of ' NTDs (fetal brain development defects). But Gamma statistic (λ= -0.101, p = .188) showed a negative relation. Which shows the women from lower-income families had more babies affected with fetal brain development defects comparably to high-income families' women. Consequently, the hypothesis "The economic status of the women would be influencing prevalence of NTDs" is partially accepted.

In case of hypothesis 2, chi-square test determined the relationship between type of marriage of the participants and prevalence level of Fetal brain development defects.. There is an association between "type of marriage of the participants and prevalence level of Fetal brain development defects. and that is statistically significant ($\chi 2$ = 5.80, p = .055) So, the hypothesis H2 "type of marriage(cousin marriage) and prevalence level of Fetal brain development defects" is accepted.

In case of hypothesis 3, chi-square determined the relationship between education level of mothers and prevalence level of Fetal brain development defects. There is a strong, positive correlation between " education level of mothers and prevalence level of Fetal brain development defects " and that is statistically significant ($\chi 2 = 42.89$, $p = .000$) But Gamma statistic ($\lambda = -0.392$, $p = .000$) showed a negative relation. Which shows the illiterate mothers had produced more babies affected with fetal brain development defects in comparison with literate mothers. from So, the hypothesis H3 " is accepted

Table 4
Hypothesis (H1) testing results with respect to Prevalence Level of Fetal Brain Development Defect

Socio-Cultural Factors Family Income (PKR)	Prevalence level of NTDs			Total
	Low	Medium	High	
Up to 15,000	162	85	36	283
	57.2%	30.0%	12.7%	100.0%
16,000-30,000	30	19	17	66
	45.5%	28.8%	25.8%	100.0%
Above 30,000	57	24	20	101
	56.4%	23.8%	19.8%	100.0%
Total	249	128	73	450
	55.3%	28.4%	16.2%	100.0%
Chi-square = 10.04 d.f. = 4			P-value = .050**	
Gamma (λ) = -0.101			P-value = .188^{NS}	

Table 5
Hypothesis (H2) testing results with respect to Prevalence Level of Fetal Brain Development Defect

Type of marriage	Prevalence level of NTDs			Total
	Low	Medium	High	
Endogamy	142	79	53	274
	51.8%	28.8%	19.3%	100.0%
Exogamy	107	49	20	176
	60.8%	27.8%	11.4%	100.0%
Total	249	128	73	450
	55.3%	28.4%	16.2%	100.0%
Chi-square = 5.80 d.f. = 2			P-value = .055*	
Gamma (λ) = -0.190			P-value = .023*	

Table 6
Hypothesis (H3) testing results with respect to Prevalence Level of Fetal Brain Development Defect

Education level	Prevalence level of NTDs			Total
	Low	Medium	High	
Illiterate	94	88	44	226
	41.6%	38.9%	19.5%	100.0%
Primary	26	12	10	48
	54.2%	25.0%	20.8%	100.0%
Middle	63	17	10	90
	70.0%	18.9%	11.1%	100.0%
Matric or above	66	11	9	86
	76.7%	12.8%	10.5%	100.0%

Total	249	128	73	450
	55.3%	28.4%	16.2%	100.0%
Chi-square = 42.89 d.f. = 6		P-value = .000**		
Gamma (λ) = -0.392		P-value = .000**		

The H4 ,H5 ,H6 are presented in the table 7,8,9 and chi-square test was applied to determine the relationship between Education level of responden't husband and prevalance level of Fetal brain development defects. Statistics (χ2) displays a significant (χ2 = 34.95, *p* = .000) association among the participants husband education and prevalance level of ' NTDs (fetal brain development defects). But Gamma statistic (λ = -0.207, *p* = .000) showed a negative relation. Which shows the Which shows wives of illiterate husbandshad delivered more babies affected with fetal brain development defects as compared to literate husbands' wives. Consequently, the hypothesis is accepted.

In case of hypothesis 5 chi-square test determined the relationship between place of residence of participant and prevalence level of Fetal brain development defects. There is an association between " place of residence of participant and prevalence level of Fetal brain development defects. and that is statistically significant (χ2 = 5.99, *p* = .054) So, the hypothesis H5" is accepted.

In case of hypothesis 6, chi-square determined the relationship between participants' maternal health-seeking behavior and prevalence level of Fetal brain development defects. There is a strong, positive correlation between " participants' maternal health-seeking behavior and prevalence level of Fetal brain development defects " and that is statistically significant (χ2 = 18.05, *p* = .001) But Gamma statistic (λ = -0.136, *p* = .055) showed a negative and significant association between variables. So, the hypothesis H6 is accepted

Table 7
Hypothesis (H4) testing results with respect to Prevalence Level of Fetal Brain Development Defect

Socio-Cultural Factors Education level of respondent's husband	**Prevalence level of NTDs**			**Total**
	Low	Medium	High	
Illiterate	117	86	34	237
	49.4%	36.3%	14.3%	100.0%
Primary	13	13	11	37
	35.1%	35.1%	29.7%	100.0%
Middle	41	17	15	73
	56.2%	23.3%	20.5%	100.0%
Matric& above	78	12	13	103
	75.7%	11.7%	12.6%	100.0%
Total	249	128	73	450
	55.3%	28.4%	16.2%	100.0%
Chi-square = 34.95 d.f. = 6			P-value = .000**	
Gamma (λ) = -0.207			P-value = .000**	

Table 8
Hypothesis (H5) testing results with respect to Prevalence Level of Fetal Brain Development Defect

Place of Residence	**Prevalence level of NTDs**			**Total**
	Low	Medium	High	
Rural	163	88	61	312

	52.2%	28.2%	19.6%	100.0%
Urban	86	40	12	138
	62.3%	29.0%	8.7%	100.0%
Total	249	128	73	450
	55.3%	28.4%	16.2%	100.0%
Chi-square = 5.99 d.f. = 2			P-value = .054*	
Gamma (λ) = -0.201			P-value = .014*	

Table 9
Hypothesis (H6) testing results with respect to Prevalence Level of Fetal Brain Development Defect

Maternal Health seeking behavior	**Prevalence level of NTDs**			**Total**
	Low	Medium	High	
Low	85	62	37	184
	46.2%	33.7%	20.1%	100.0%
Medium	124	41	20	185
	67.0%	22.2%	10.8%	100.0%
High	40	25	16	81
	49.4%	30.9%	19.8%	100.0%
Total	249	128	73	450
	55.3%	28.4%	16.2%	100.0%
Chi-square = 18.05 d.f. = 4			P-value = .001**	
Gamma (λ) = -0.136			P-value = .055*	

Multivariate Analysis
Socio-economic and cultural factors associated with the prevalence of fetal brain development defects

Table 10
Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.635[a]	.403	.391	.586

a. Predictors: (Constant), Maternal health-seeking behavior, Family Type, Age, Place of Residence, Husband's Education, type of marriage, Family Income, Education

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	101.961	9	11.329	32.97	.000[b]
	Residual	151.203	440	.344		
	Total	253.164	449			

a. Dependent Variable: Occurrence of NTDs (fetal brain development defects)

b. Predictors: (Constant), Maternal health-seeking behavior, Family Type, Age, Place of Residence, , Husband's Education, Type of Marriage, Family Income, Education

Table 11
Association of Socio-economic and cultural factors with the prevalence of fetal brain development defects

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig
		B	Standardized Coefficients	Beta		
1	(Constants)	1.571	.149		10.530	.000
	Age	.069	.072	.051	.955	.340[NS]
	Education	-.250	.074	-.404	-3.394	.001**
	Husbands' Education	-.102	.058	-.172	-1.857	.050*
	Family Income	-.729	.095	-.808	-7.667	.000**

Type of Marriage	.711	.087	.474	8.183	.000**
Place of Residence	-.651	.153	-.400	-4.255	.000**
Family type	-.081	.123	-.054	-.656	.512^{NS}
Maternal health seeking behavior	-.165	.081	-.161	-2.047	.041**

a. Dependent Variable: Occurrence of NTDs (fetal brain development defects)

For checking the association of model R2 along the model adjusted R2 as well as F-Test in multiple regression analysis are supposed to be used. Values of R2 along with adjusted R2 As well as F-Test were being analyzed and calculated 0.403, 0.391 and 32.97. it is stated that value range of R2 highlighted the fact that near about half forty percent of the variation within neural tube defects /FBD Defects being represented and elaborated with the help of eight explanatory variables being a part of that model. Because of use of primary data the estimated value is quite high but the overall model considers to be reliable, F-test was supposed to be used for the reliability check of the model.Its calculated value of 32.97 happens to be statistically significant at less than one percent level of significance Which clearly shows that all the independent indicators or variables being a part of model are giving clear picture and explanation of the dependent variable. Dependent variable within the following model of regression is the prevalance of NTDs (fetal brain development defects), all fetal brain development defects were measured with a 5-point Likert scale. The impact of five explanatory variables i.e. Respondent's own Education, Husbands' Education, Family Income, Place of residence, and maternal health-seeking behavior were statistically significant and had a negative relation with the occurrence of NTDs (fetal brain development defects). However, the type of marriage endogamy marriages (cousin marriage) had a significant impact on the occurrence of NTDs (fetal brain development defects). Furthermore, the type of family showed no association with the occurrence of NTDs (fetal brain development defects).

Conclusion

One of the significant global health challenge is Fetal brain development defects, which varies in prevalance rates from region to region and associated factors in its occurrence. In the region of Punjab, Pakistan, understanding the landscape of these defects and the associated influences is crucial for effective prevention and intervention strategies. This study helped us understand more about why these defects actully happen and how can we prevent. factors like socio-economic status, cultural influences play vital role in shaping the prevalance rates of Fetal brain development defects (hydrocephalus & spina bifida) in our regions. By implementing programs that focus on improving mass awareness, access and quality of prenatal care, enhanced healthcare infrastructure, and support to families affected by brain development defects, the government can act as a game changer for improving the well-being of the population. The information we found shows that we need to do more to help families dealing with this issue. It's a serious problem that needs our attention and support.

Recommendations

Improving the mother and child health overall and eradicating the prevalence of NTDs in our country in future requires lots of efforts with a broad range of measures, legislations and policies at government /macro to micro /household level .Here are some suggestions based on this study , field experience and detailed discussion with mothers as participants about the most effective method to eradicate micronutrient maternal malnourishment in our country and fetal brain development defects being a worse outcome of that:

Socio-economic status the most important predictor of mother and child health, so government should specialy focus on enhancing literacy rate, life standard, practices regarding health and hygiene for achieving SGD for reducing burden of disease in

Pakistan. Antenatal & post-natal care centers are overcrowded or at far off places most of the time. Govt should recruit more General Practitioners in public health care regieme and train the existing ones to improve the ANC facilities available for public.

Mass Campaigns of awareness about maternal malnutrition and NTDs causes and consequences as well as its solutions in form of supplement, fortified food intake should be run immediately. Involvement of social influencers (religious scholars, doctors, actors, leaders,) for awareness about this issue is necessary.

Counseling of husbands/mothers in law for Awareness of nutritional deficiencies/outcomes and importance of balanced diet and supplements as wel as fortified food should be done.Midwives/LHV Intervention for maternal counseling about balanced diet , fortified food, use of supplements as well as Giving reminder messages to them being door to door available.

Poverty is the main cause of unaffordability of healthy food before or during pregnancy that substandard diet leads towards the maternal poor health status and consequently comes up with NTDs in children. Nevertheless, provision of free IFA supplements at the doorstep by health workers is highly necessary for such anemic and food insecure women.the Surgery/treatment cost of affected babies for needy families should be eliminated .NTDs specialized care department and neurosurgeon should be available in every DHQ atleast.

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