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### Original Article

## Socioeconomic status parental occupation and neural tube defects

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#### ABSTRACT

A case control study was carried out to investigate association between NTD and occupational exposures of the parents. We collected data using personal contacts and from the patients visited at the hospitals/clinics giving a questionnaire asking about their occupational title, age, parity and occupational activities. The analyses of occupation showed a  $\chi^2$  value for mother and father occupations were 12.08 & 9.53 respectively. Both the values differ significantly while compare with the controls. The results of the present study suggest an increased risk of NTD infants of parents in labourer as an occupation, but they do not provide insight into any specific occupational risk factors.

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### 1. Introduction

Congenital anomalies (CAs) are important causes of mortality and morbidity in childhood. The aetiology of most congenital anomalies still remains unknown, although there are a few well established and avoidable external risk factors. It is likely that a number of external unknown contributory factors are yet to be identified, but we need to know where to instigate searching, and beginning with social correlates may be a starting point. Some factors viz. like diet, occupational and environmental exposures (like chemical use in the workplace) will correlate with low social status and if these factors play a causal role in CAs, the occurrence of CAs may be associated with social status [1]. Identifying social indicators of CAs after adjusting for lifestyle factors can, therefore, be measured a screening tool to focus future studies on environmental factors. Analysing CAs with and without adjusting the social condition provided some clues about the discovery of the micronutritional aetiology of neural tube defects [2-4].

Neural Tube Defects (NTD), which are among the more serious and common congenital defects. The etiology is still unknown, both genetic and environmental factors seem to play an important role in the causation of the defects. The factor, which seems to be associated with the prevalence of NTD is socioeconomic status of

the parents. Several studies have reported a relation between NTD and socioeconomic status [5-9] reported the association between socioeconomic classes, vitamin levels and NTD, epidemiological research into the role of vitamins and folic acid in particular, has increased. Some studies alone provide evidences for a protective role of periconceptional multivitamins containing folic acid or folic acid supplementation [10-12].

As the classification of socioeconomic status is primarily based on occupation, however, the presence of potential teratogens in the work environment could be an additional explanation for the differential prevalence rates of NTD and socioeconomic classes. Maternal occupational exposure before conception and in the first month of embryonic development could have direct bearing on the morphogenesis of the neural tube. A few studies have been performed to investigate the relation between parental occupation and NTD. Some evidence was found for an increased risk among persons working in industry, construction, transport, farming and communication [13-15]. All investigators looked at a broad range of occupations in these types of studies. A few studies have more than three hundred cases [16] and most studies had relatively limited data on occupational titles, derived from birth registries. These limitations probably contributed to inconsistencies in results. The purpose of the present study, which used self-assessed occupational titles, is to identify clearly the parental occupations that are associated with an increased risk of having a child with neural tube defects.

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## 2. Materials and Methods

The cases were live born children with neural tube defects (International Classification of Diseases (ICD-9) codes 741.0 and 741.9) who visited hospital/clinics for treatment. We identified 287 cases with the help of pediatricians and gynecologist. All the cases had a clinically confirmed diagnosis of NTD. We also obtained control group recruited through random samples. Information was collected through a combination of written questionnaire and personal interview during the investigation. In general multiple contacts were used to collect even minute information. SES was measured by the mother's and the subject's biologic father's education, occupation, and household income. Education was the highest grade or years of school or college completed by each parent at the time of delivery.

A standardized questionnaire was given to the parents attended by the subject. The cases and control subjects were personally contacted. Clinical records were used to verify selected responses and to answer as many of the questionnaire items as possible when a subject could not be interviewed. The clinician were aware of the status of the subjects, but neither they nor the subjects were informed the study hypothesis. Controls were live born infants without major birth defects, randomly selected from birth certificates or birth hospitals reflecting the same study populations as the cases.

During the analysis we grouped occupations with the largest possible specificity, taking account of the numbers in the strata. If splitting the occupations into smaller, more specific categories did not yields differential results. We concentrated several occupation into the main clusters to which they were closely related.  $\chi^2$  and student t-test for the different occupation using the controls were calculated.

## 3. Results

Table I present the distribution of paternal and maternal occupations and demographic factors of socioeconomic status. In the present study the number of cases reported from mothers' occupation is as 93 are labourers, 106 housewives, 54 belongs to working class and 34 are others respectively. On the other hand the distribution of occupation of father 150 was labourers, 78 belong to working class, 29 skilled workers, 21 professional and 9 were others. In the present study our main interest focused on the labourer class. In both the cases the  $\chi^2$  value obtained was 12.08 and 9.53 respectively and significantly varies at 0.05 probability level (Table-2).

We also calculated correlation coefficient among malformation, occupation and age of the mother. Correlation coefficient was obtained in order to study the degree of relationship between malformation and each predictor variable. Correlation coefficient (r) obtained between mothers' occupation and malformation equals to 0.18. The correlation found between them is positive and significant at 0.01 probability level. The r between age of mother and mothers' occupation was negative (-0.35) and significant  $p < 0.01$ . The results of multiple regressions have been summarized in table-3. It may be noted from the table that

multiple correlation (R), which represents the degree of association between malformation and a set of five independent variables, equals to 0.212. The f statistics applied to check the significance of R yielded a value of 2.19. The df being 6 and 280. The obtained value of R was significant at 0.05 probability level. The multiple regression analysis suggests that all the six independent variables jointly determine malformation with 95% confidence level. The relative contribution of each of the predictors in overall contribution may be noted from regression coefficients. Larger the regression coefficient more the predictive value.

**Table.1 Characteristics of infants with birth defects and control**

Socioeconomic Status	Cases (N=287)	Control (N=110)	
<b>Age of Mother</b>			
18-22	40	28	
23-26	125	37	10.68
27-33	85	30	
>33	37	15	
<b>Mothers' occupation</b>			
Labourer	93	42	
Working Class	54	29	12.08
Housewives	106	20	
Others	34	11	
<b>Paternal Occupation</b>			
Labourer	150	37	
Working Class	78	34	9.53
Skilled worker	29	16	
Professionals	21	13	
Others	09	10	
<b>Birth Order/Parity</b>			
0	08	00	
1	133	57	
2	99	36	4.95
3	37	17	
4	10	00	

**Table -2 Effects of Parental Occupation in Cases and control Parents**

Mothers' Occupation	Mean ± SD	95% CI	Range	t
Cases	2.53 ± 0.07	2.38 ± 2.68	1-4	2.21
Control	2.22 ± 0.12	1.99 ± 2.45	1-4	
<b>Paternal Occupation</b>				
Cases	1.93 ± 0.07	1.78 ± 2.07	1-5	3.13
Control	2.43 ± 0.13	2.13 ± 2.66	1-5	

**Table.3 Multiple Regression between Age and Parental Occupation**

Variables	Mean	Regression Coefficient
Age of Mother ( $x_1$ )	24.52	0.002
Parity ( $x_2$ )	1.68	-0.033
Mothers' occupation ( $x_3$ )	2.53	0.153
Fathers' occupation ( $x_4$ )	1.93	0.006
Diet ( $x_5$ )	1.55	0.045
Malformations (Y)	2.91	

**Multiple (R) = 0.212,  $R^2 = 0.045$**

**Significance of R: F = 2.19, df = 6 & 280,  $p < 0.05$**

#### 4. Discussion

The result of the present study points to a slightly increased risk for the parents working as labourers. The broad category of labourers that we used in the study may comprise a diversity of tasks and activities and varying chemical or physical exposures. Due to small numbers, however it is not possible to subdivide this category into homogeneously exposed groups. As a result random misclassification might have biased the  $\chi^2$  value. In the present study, infants with NTD were reported at the hospitals/clinics. Every diagnosis that was doubtful or unclear was checked with the help of pediatrician/gynecologist. Therefore, diagnostic specificity is very high. The potential biological mechanisms of maternal physical activity on adverse reproductive outcomes are unclear. Barends et al., [17] proposed the pathway through which components of physical activity may act on fetal development. They hypothesized that physiological responses to continual stress job loads produces changes in the production of catecholamine hormone decrease blood flow, placental function, increase uterine irritation and constrain fetal movements because of certain maternal postures. As a result the oxygen supply and nutrients to the growing fetus reduced and restrict resources for the fetal development [17]. Some studies indicate an increased risk for NTD when congenital defects are divided into categories. The study of Holmberg and Nurminen also in agreement with our study who found that mothers of a baby with central nervous system malformation had been exposed to organic solvents during the first trimester of pregnancy when compared with the controls. Chemical exposure reduces the sperm quality and fertility. The increased risk of NTD or anencephalus also recorded in welders, transport and communication workers who were mainly drivers of road vehicles [18].

Although, a few studies have been carried out with the specific aim of investigating relation between NTD and parental occupational exposures. The specific relation between risk of NTD and occupation of the parents has not been investigated properly and in the majority of cases only register based data is used instead of information about exposures given by the parents. Because of the limitations and methodological differences, it is difficult to draw any conclusions. Although, there are some occupations that appear to have a higher risk of having offspring with NTD. With regards to mothers sample size is sometimes very small to find out any association, but in some mothers working as labourers have a

higher risk of having offspring with CNS malformation [19-22]. With respect to father, it has been found that labourers (painters, printers, drivers, and farmers) probably have a higher risk of having children with NTD. Low social status is a well-established risk indicator for a range of adverse perinatal and infant outcomes such as low birth weight and perinatal, neonatal and post neonatal mortality. Surprisingly, few studies have examined social inequalities of the prevalence of CAs [23,29]. In a society where both partners work, social conditions depend on both the male and the female educational and economic contribution to the family, while personal behaviours and attitudes may depend mostly on individual characteristics. In the past, NTD occurred more frequently in low social groups, which probably relates to diet habits with a low folic acid intake among poorly educated women with a low income [6].

#### 5. Conclusion

As the results are not always consistent with each other that's why conclusion about the etiology of NTD at this stage cannot be drawn. More studies are needed to reach at any specific conclusion.

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