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# NEURAL TUBE DEFECTS IN NEWBORNS IN THE SOUTH-EAST OF THE CASPIAN SEA BORDER (GORGAN, IRAN 1998-2000)

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## ABSTRACT

Neural tube defects (NTD) are one of the most important malformations of newborns. The aim of this research is to determine the rates of NTD, anencephaly and spina bifida cystica and the relations of these abnormalities to the factors including sex, race, ethnicity, maternal age and familial marriage in the south-east of the Caspian Sea border.

A three-year descriptive-analytic and cross-sectional study was carried out on 19545 newborns deliverd in Dezyani hospital in Gorgan during 1998-2000.

From the total sample population (19545), the NTD rate was 3.12 per 1000 deliveries. In males the rate was 2.49 per 1000, in females 3.79 per 1000, and the female to male ratio was 1.44:1. The rate of anencephaly and spina bifida was 1.25 per 1000 and 1.74 per 1000 respectively. In regard to different races the NTD rate was 7.48 per 1000, 9.5 per 1000, and 2.35 per 1000 among Turkmans, Sistanis and Farses, respectively.

It can be concluded that there is a higher rate of NTD in this region that may be due to the race-ethnicity and the ecological variations.

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**Keywords:** neural tube defects, anencephaly, spina bifida cystica, Iran.

## INTRODUCTION

In humans, the neural tube forms approximately on embryonic days 16 through 27 and is believed to have multiple sites.[1,2]

Neural tube defects (NTDs), the most common of which are anencephaly, spina bifida and encephalocele, result from multifactorial disturbances in embryonic neurulation.[3] Numerous risk factors have been identified for NTDs. Exposure to valproic acid/carbamazepine,[4] methotrexate[5] and aminopterin,[6] maternal diabetes,[7,8] low socioeconomic status/poverty[9] and hyperthermia[10] have been shown to increase the risk of NTDs. The estimated lifetime cost of a single case of spina bifida has been estimated to be around US $300,000 in 1992 and is probably even more now.[11,12] The prevalence of NTD at birth varies considerably by country and ethnic group, and ranges from as high as 1 case in 100 births in some regions of China to about 1 case in 5000 or less in some Scandinavian countries. In many countries the prevalence is approximately 1 in 1000 births.[11]

Genetic risk factors are believed to be important.[13] This study was done in the north of Iran, the Caspian Sea border (Gorgan), due to different races and ecological factors. We tried to find a relationship between the NTDs and the following factors: ethinicity, sex, maternal age and consanguinous marriage and also to find the incidence of NTD in this region.

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## PATIENTS AND METHODS

This was a descriptive and cross-sectional study.

Cases were defined as women residing in Gorgan who delivered a live or stillborn infant with a neural tube defect during April 1, 1998 through December 12, 2000 in Dezyani hospital. The mother's race, ethnicity and age, consanguinous marriage and newborn sex were recorded in the medical chart. All NTD rates were calculated per 1000 births. Demographic characteristics of the malformed infants (with anencephaly and spina bifida) and their parents were recorded and the data analyzed with SPSS. The NTDs were evaluated and compared using statistical chi-square test.

## RESULTS

During 1998-2000, there were 19545 births in Dezyani hospital. Among this sample population there were 9511 girls and 10034 boys. There were 6273 infants in 1998, 7042 in 1999 and 6130 in 2000. 78.36% of the population were Fars, 10.26% Turkman and 11.38% Sistani. During 3 years of study, we found 61 live and stillborn infants with NTDs (36 girls and 25 boys). The rate of NTDs was 3.12 per 1000 births. This rate was 2.49 per 1000 for males, and 3.79 per 1000 for females. The female/male ratio of NTDs was 1.44. Chi-square statistical test did not show any meaningful relationship with sex.

From 61 infants with NTDs, 44 had either anencephaly or spina bifida and in 17 cases both of them were seen. Fig. 1 shows the distribution of NTDs on the basis of sex and year.

The rates of NTDs in 1998, 1999 and 2000 were 3.02, 2.84 and 3.6 per 1000, respectively. Table I shows the rate of anencephaly and spina bifida cystica according to the year and sex of infants.

In this research the prevalence of NTDs of infants was determined according to the different races. The study indicated that 15 cases were Turkman, 36 cases Fars and 10 cases were Sistani (Table II). Turkman's NTDs rate (7.48 per 1000), was higher than Fars' (2.35 per 1000) and Sistani's (4.5 per 1000). However this difference was not statistically meaningful. Also we compared anencephaly and spina bifida separately and the following results were concluded: the rate of spina bifida in total population was 1.74 per 1000, in which the rate was 1.3 and 2.21 for males and females, respectively. The above findings concerning anencephaly were 2.25 per 1000 for total newborns and 1.8 and 2.7 per 1000 for males and females, respectively. The mean age of mothers was 25.69±5.73 years. Most NTD infants were born in the end of autumn and the beginning of winter. Our study indicates that about 30% of parents of infants with NTDs had familial marriage, 46% of them resided in the villages and 54% in urban areas. This difference was not statistically significant.

## DISCUSSION

NTDs are severe congenital abnormalities and one of the most important reasons of morbidity, mortality and physical disability among newborns and infants.[14-16] NTDs are the second most common congenital malfor-

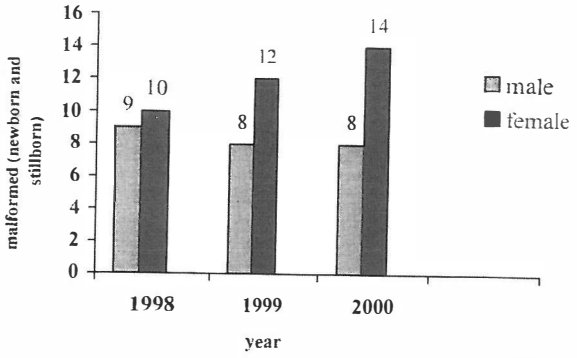


**Fig. 1.** Distribution of NTDs on the basis of sex and year.

**Table I.** The rate of NTDs on the basis of sex, year and the type of malformations.

| Year | Malformation | Male | Female | Total |
|---|---|---|---|---|
| 1998 | Spina bifida | 3 | 4 | 7 |
| | Anencephaly | 3 | 2 | 5 |
| | Spina bifida+anencephaly | 3 | 4 | 7 |
| 1999 | Spina bifida | 1 | 3 | 4 |
| | Anencephaly | 5 | 6 | 11 |
| | Spina bifida+anencephaly | 2 | 3 | 5 |
| 2000 | Spina bifida | 3 | 3 | 6 |
| | Anencephaly | 4 | 7 | 11 |
| | Spina bifida+anencephaly | 1 | 4 | 5 |

**Table II.** Distribution of NTDs on the basis of sex, race/ethnicity and relation to the type of malformations.

| Race | Malformation | Sex | | Total | Rate/1000 |
|---|---|---|---|---|---|
| | | Male | Female | | |
| Turkman | Spina bifida | 2 | 2 | 15 | 7.48 |
| | Anencephaly | 5 | 3 | | |
| | Spina bifida+anencephaly | 0 | 3 | | |
| Fars | Spina bifida | 5 | 7 | 36 | 2.35 |
| | Anencephaly | 2 | 12 | | |
| | Spina bifida+anencephaly | 5 | 5 | | |
| Sistani | Spina bifida | 0 | 1 | 10 | 4.5 |
| | Anencephaly | 4 | 1 | | |
| | Spina bifida+anencephaly | 1 | 3 | | |

mation after congenital heart malformations in the USA.[15,16] In humans, the neural tube approximately forms on embryonic days 16 though 27.[1,2] The most common type of these malformations are anencephaly and spina fibida cystica which result from disturbances in embryonic neurulation.[3] The present study was done to find out the rate of NTDs (anencephaly and spina bifida cystica) and some other related factors during three years in Dezyani hospital of Gorgan University of Medical Sciences. Our results indicated that the rate of NTDs was 3.12 in 1000 which is higher than other studies such as Arbabi in Tehran[17] which was 1/1000, in Canada[18] 1.41/1000, in the north of England[19] 17.9/10,000, in Turkey[20] 30.1/10,000, in the north of France[21] 10.94/10,000 and in the USA[22] (California) 9.3/10,000, (Atlanta) 11.3/10,000, (South Carolina) 14.6/10,000 and Texas 14.6/10,000. This rate is lower than that of China[23] which was 6/1000, in Wales and Ireland[24] 5-7/1000 and in the east of Ireland[25] 46.9/10,000 in 1980. Regarding sex difference, our results indicate that the rate of NTD in females is more than males which is the same as that reported by other researchers.[17,22,26,27]

The results like the studies by other researchers also indicate the differences of NTD rate among different races.[22,28-30] From such studies we can point out two[29,31] that determined the rate of NTDs in newborns of white mothers to be higher than in black mothers and also in Hispanic women to be higher than Anglos. Therefore we can conclude the role of race and ethnicity in the rate of NTD which is the same as other researches.[32,33] Other results confirmed that the Turkman race had a higher NTD rate. Therefore further studies are required to find out why the Turkman race is more commonly affected. The male to female NTD ratio in our study was 0.7 for all NTDs, 0.7 for anencephaly and 0.6 for spina bifida. But another research in the USA indicates that overall the NTD ratio was 0.62, for anencephaly 0.54 and for spina bifida 0.68, which except for anencephaly their findings are nearly the same as ours.

Among NTD malformations the rate of cystic spina bifida in the total population of our study was 1.74 per 1000 which is higher than the results of others studies such as 0.62/1000 in France,[27] 7.1 per 1000 in Texas[22] and 1.09 per 10,000 in Saudi Arabia.[34] It should be mentioned that our finding (1.74/1000) is nearly equal to the other study which was done in Tehran (1.8 per 1000).[17] Our results were also comparable to studies which have reported a higher rate of spina bifida in females than males.[14,22,34-36] The rate of anencephaly in our investigation was 2.25 per 1000 which is higher than the other studies such as 6 per 10,000 in the USA,[36] 0.33 per 1000 in Strasburg,[37] 6.4 per 10,000 in Texas[22] and 1 per 1000 in Tehran.[35] In addition, in a separate study in the USA the rates of anencephaly in California, Atlanta, and South Carolina were 3.6, 4.8, and 5.2 per 10,000, respectively.[22]

The rates of anencephaly in this study and other studies have the same finding, i.e. a higher incidence in females.[11,12,14,16,17,27,38]

Our other finding, the time of conception, which took place in late winter, confirmed other investigations.[27]

The average maternal age in NTD subjects was $25.69 \pm 5.73$ years which is higher than mothers of normal newborns. In this study 30% of parents had familial marriages.

In regard of the high rate of NTD in this region and due to multifactorial causes of NTD we concluded that consanguinous marriage may play a role in predisposition to NTD. Therefore, further studies on the chromo-

somal and genetic aspects of such abnormalities are essential.

For an unknown reason that we can not explain at present, the results of this study show that the rate of NTD has been increasing in recent years (1998 through 2000). Variation of race, ethnicity and other contributing factors such as ecological condition and many toxic substances used in agriculture and consanguinous marriage and also nutritional factors like folate deficiency may play roles in the increasing NTD rate in this region. So further investigations are recommended in this field of research, and we recommend that an independent center has to be established to register all these malformations in the south-east of the Caspian Sea which has a long border with Turkmenistan.

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