

Trends of sex ratios in an urban Saudi Arabian population

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ABSTRACT

Objectives: This study analyzes the distribution of sex ratio at birth in a Saudi population using data collected from the birth database of an urban teaching hospital and to assess the potential effect of the gulf war on it.

Design: Database on all hospital births was used to calculate the sex ratios for all live births.

Setting: Births at King Khalid University Hospital (KKUH), Riyadh, Saudi Arabia totaling 67,643.

Subjects: All live births from 1983 -2000.

Outcome Measure: Sex ratio male/female (expressed as the proportion of the total live births that were males).

Results: The average sex ratio from 67,643 births, was 1.033 (95% CI, 1.029-1.037), significantly different from the world average of 1.055. The male proportion at King Khalid University Hospital, Riyadh, decreased significantly after 1990 (Gulf war). This represented a cumulative loss of 15.7 male births per 1000 live births from 1983-2000.

Conclusion: The decreased sex ratio observed in our study as well as in other parts of the world add to the importance of the effect of environmental factors on the reproductive health of populations, in addition to the sensitivity of the sex ratio as an unambiguous marker for that.

Key Words: Sex ratio; Trends; Saudi Arabia; Male proportion.

Declining trends in sex ratio, expressed as the proportion of the total live births of males (male proportion) at birth, observed in several Western countries have not been fully investigated in middle-income developing countries such as Saudi Arabia. Sex ratio can vary within and between populations and change over time due to the affects of psychosocial, demographic and environmental factors capable of interfering with human reproduction. For several decades the decline in the ratio of male-to-female births in industrialized countries has been attributed to exposure to pollutants capable of interfering with human reproduction. It has been postulated that the

mechanism of action of some toxins may be similar to hormonally induced ovulation which cause an excess of female births and that the toxins may alter female gonadotropin level at the time of conception. While the specific factors responsible for the decline remain to be fully elucidated, exposure to environmental toxins has been shown to alter the sex ratio of live births in both human population and animal models (1-5). In addition, several other factors have been reported to affect sex ratios, including seasonal changes, stress, war, birth order, certain diseases and various social factors including religion (6,7). Trends in the sex ratio of live births have not been previously investigated in Saudi Arabia. The effects of urbanization and increasing industrialization that have taken place in Saudi Arabia during the last half the past century on reproductive health have not been fully investigated. Therefore, we sought to examine the trends in the sex ratio in an urban

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Table 1. The frequency of births, sex ratio, male proportion and cumulative loss in male proportion over the study period.

Year	No. of Males	No. of Females	Sex Ratio	Male Proportion	Cumulative Loss
1983	554	504	1.09	0.52	
1984	828	810	1.02	0.50	1.8
1985	1181	1138	1.04	0.51	3.2
1986	1689	1510	1.12	0.53	2.8
1987	1935	1755	1.10	0.52	2.7
1988	1765	1691	1.04	0.51	4.0
1989	2182	1901	1.15	0.53	2.9
1990	2310	2073	1.11	0.53	2.6
1991	2324	2314	1.00	0.50	4.8
1992	2313	2130	1.08	0.52	5.1
1993	2271	2276	0.99	0.49	7.5
1994	2341	2013	1.16	0.54	6.1
1995	2169	2096	1.03	0.51	7.6
1996	2063	2061	1.00	0.50	9.9
1997	2198	2018	1.09	0.52	10.2
1998	2339	2294	1.02	0.50	12.1
1999	2252	2122	1.06	0.51	12.9
2000	2092	2131	0.98	0.49	15.8

Saudi Arabian population and assess the possible effects of demographic and psychosocial disruptions caused by the Gulf war of 1990-91.

MATERIALS AND METHODS

The data were obtained from King Khalid University Hospital (KKUH), Riyadh, Saudi Arabia database of all births from the period 1983 to 2000. From this information the annual male proportion was calculated by dividing the number of live born males by the total number of live births for each study year, in addition to the sex ratio (the proportion of the live born males to females). The data were analyzed semiparametrically using a generalized additive model to fit a smooth non-linear trend to male proportion from 1983 - 2000. The data were then examined for trends. We used ordinary logistic regression to fit and test the trends. Estimated 18-year trends and 95% confidence intervals (CIs) were derived from the fitted values and their asymptotic multivariate normal distribution. The cumulative loss was then calculated.

RESULTS

Trends in sex ratio, which varied in slope and shape, were observed over the 18-year period. Examination of the smoothed trend in the male proportion from 1983 to 2000 (Fig. 1) revealed a small increase in the male proportion until 1990 and followed by a small decreasing trend. The total number of live births at (KKUH) from 1983 through 2000 was 67,643 with 3757.9 per year on average. Table 1 shows the frequency of births, sex ratio, male proportion and cumulative loss at (KKUH) over an 18-year period. The male proportion decreased significantly overall during this period for a cumulative loss of 15.7 male births per 1000 live births (Fig. 2). The cumulative loss of 1061.9 live born males observed in our data at KKUH over the study period was highly significant.

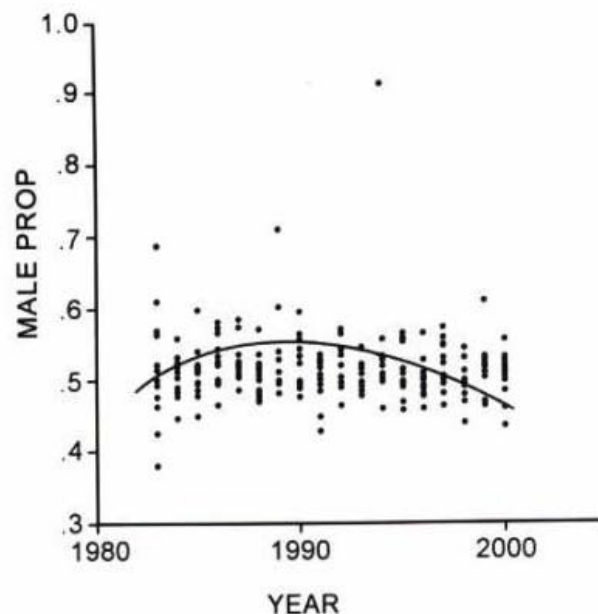


Figure 1. Smoothed curve of deviations in the sex ratio trend (male proportion) in Riyadh (KKUH-Saudi Arabia) from 1983 to 2000.

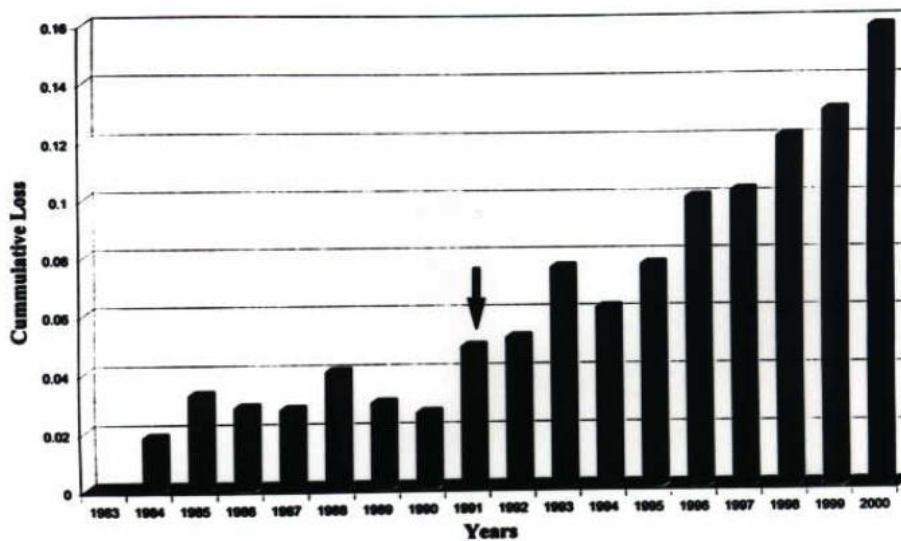


Figure 2. Diagram showing the estimated trend in the cumulative loss in male proportion at KKHU for 18 years.

DISCUSSION

This is the largest study ever undertaken to determine trends in sex ratio at birth in Saudi Arabia, and the first study after the Gulf war of 1990-91. The results of this study confirmed the findings of other studies showing a decline in the proportion of male births in Europe, although differences exist by region and country (8). Several factors including social and cultural aggregations of countries with decreasing trends suggest that sociodemographic characteristics might be more likely to explain the trends (8). Our findings of declining sex ratio after the war support the hypothesis that acute psychologic stress induced by war in Saudi Arabia has an influence on children conceived during and after exposure. Other studies (8) suggested that the psychologic pressure with constant menace of a military attacks presumably exerts negative effects on sperm quality particularly sperm motility and a higher proportion of X-bearing sperm. Although our data from a teaching hospital have the limitations of being institutional as compared to large population databases, the decrease in the sex ratio observed in our study provides a measure of the reproductive health of the population at large. While Riyadh, the

capital of Saudi Arabia is separated by about 750 Km from Kuwait and about 350 km from the eastern region which was affected by the Persian Gulf war (1990), it was the base of the military command unit and also the target of several scud missiles. Although, Cowan and colleagues (9), did not observe a similar trend in sex ratio between children of the Gulf war veterans and the children of the non-deployed veterans, our observation of a decreasing trend in the male proportion over a longer time observation (8 years post war) may reflect the influence of a combination of stress related to the war as well as the effects of war-related environmental toxins on the reproductive health of the population of Saudi Arabia.

It is important to note that abortion is prohibited in Saudi Arabia and only allowed for strict medical reasons that threatens maternal health. Therefore selective female fetacide could not have been a factor in our observation. The human sex ratio has a very large number of variables based on two premises: the equal numbers of X and Y bearing spermatozoa and the probability that a spermatozoon fertilizes an ovum is independent of its sex chromosome.¹⁰ It follows that any variation of sex ratio at birth must also be due in part to a sex-selective fetal mortality. It is also frequently

suggested that males are at more risk of fetal wastage than females and that the sex ratio at birth reflects the health of the intrauterine environment (10). Our data neither supported nor refuted these hypotheses.

Drugs used for ovulation induction has been associated with a decreased sex ratio (11). Thus, advances in the treatment of infertility, or increased access to such treatment during the study period which is evident in Saudi Arabia may have affected the sex ratio as well. Of interest is the decreased sex ratio observed in other parts of the world but to a lesser degree for example in the United States (cumulative loss of 1.0 male per 1000 live births) and Canada (cumulative loss of 2.2 male per 1000 live births) (12). The increase in cumulative loss observed in our study noted mainly after the gulf war which could be a possible reason. On the other hand however, Maconochie (13) did not observe any significant alteration in the sex ratio among nuclear industry employees children. These observations raise the possibility of the effect of a broader range of environmental factors than have been demonstrated to influence reproductive performance, sex ratio and semen quality (3,5). Large population studies in other countries in the Persian Gulf area would be required to validate our findings and investigate the magnitude of the changes observed over a similar period of time.

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