



International Journal of  
**Cancer Research**

ISSN 1811-9727



Academic  
Journals Inc.

[www.academicjournals.com](http://www.academicjournals.com)

## High Mortalities Due to Cancers and Psychiatric Disorders in Masjid-I-Sulaiman (South-West of Iran), a Polluted Area with Natural Sour Gas

Mostafa Saadat

Department of Biology, College of Sciences, Shiraz University, Shiraz 71454, Iran

**Abstract:** Masjid-I-Sulaiman (MIS) (Khuzestan province, South-West of Iran) is contaminated with subsurface of natural sour gas leakage. In the present report the possible effect of environmentally contamination with natural sour gas on mortality due to cancers and psychiatric disorders was investigated. Data concerning mortality in MIS and Khuzestan province are compiled using reports from the Statistical Center of Khuzestan province from 20th March 2000 to 19th March 2002. The mortality in the Izeh and Shoshtar, the nearest city to MIS and the Khuzestan province (excluding MIS) were used as controls. To test the null hypothesis that the mortalities due to cancers and psychiatric disorders in MIS are equal to the control populations, the Chi-square test was used. Statistical analysis of data demonstrated that there were significant differences between MIS and Khuzestan province for cancers ( $\chi^2 = 20.58$ ,  $df = 1$ ,  $p < 0.00001$ ) and psychiatric disorders ( $\chi^2 = 43.79$ ,  $df = 1$ ,  $p < 0.00001$ ) related mortalities. There were significant differences between MIS and Izeh for cancers ( $\chi^2 = 7.24$ ,  $df = 1$ ,  $p = 0.0071$ ) and psychiatric disorders ( $\chi^2 = 17.88$ ,  $df = 1$ ,  $p = 0.00002$ ) related mortalities. Also there were significant differences between MIS and Shoshtar for cancers ( $\chi^2 = 9.23$ ,  $df = 1$ ,  $p = 0.0023$ ) and psychiatric disorders ( $\chi^2 = 9.80$ ,  $df = 1$ ,  $p = 0.0017$ ) related mortalities. There was no difference between either Izeh or Shoshtar and Khuzestan province for mortalities due to cancers and psychiatric disorders. Taken together, it is suggested that high level of sulfur compounds in MIS has some role(s) in the high mortality rates due to cancers and psychiatric disorders in MIS.

**Key words:** Mortality, cancer, psychiatric disorders, sour gas leakage, Masjid-I-Sulaiman, Iran

### Introduction

Masjid-I-Sulaiman (MIS) is located in Khuzestan province, south-west of Iran. Petroleum-whether gas, oil, or liquid asphalt- that exudes in the form of springs and seepages may reach the surface. Active seepages of oil and gas overlie the MIS oil field (Lee, 1953). Unfortunately, some parts of the MIS are contaminated by sub-surface leakage of natural gas, which contains the hydrogen sulfide. It should be mentioned that the gas dissolved in the oil of the MIS oil field contains 40% hydrogen sulfide (Levirsen, 1967).

Recently we showed that the offspring sex ratio at birth of families living in contaminated areas of MIS had significantly difference compared with the general population of MIS (Saadat *et al.*, 2002, 2003). The influence of the subsurface leakage of sour gas on the systolic and diastolic blood pressure (Saadat *et al.*, 2004a) and hematological indices (Saadat and Bahaoddini, 2004) of individuals living in contaminated areas of MIS was reported. High incidence of suicide attempts, completed suicide and suicide by self-burning in MIS was reported (Saadat *et al.*, 2004b). Very recently it was showed that MIS citizens are more at risk to be depressed and hopeless compared to control group (Saadat, 2006).

There are several reports about effects of petroleum compounds on mortality rates and causes of mortality (Divine *et al.*, 1996; Mavaluso *et al.*, 1996; Tsai *et al.*, 2001). However, there is no data about the possible effect(s) of environmental contamination with sulfur compounds on cause(s) of mortality. In the present study we are going to compare the mortality due to cancers and psychiatric disorders between MIS and control populations.

### Materials and Methods

Data concerning mortality in MIS and Khozestan province are compiled using reports from the Statistical Center of Khozestan province from 20th March 2000 to 19th March 2002, equal to Iranian calendar 1379 to 1380 Hejirae Shamsi (HS). The mortality in the Izeh and Shoshtar, the nearest city to MIS and the Khozestan province (excluding MIS) were used as controls. It should be noted that citizens of MIS and Izeah belong to the same ethnic group (named Bakhtiary). It should be noted that there is no significant difference between MIS, Izeh, Shoshtar and the Khozestan province (excluding MIS) regarding the age distribution of citizens.

To test the null hypothesis that the mortalities due to cancers and psychiatric disorders in MIS are equal to the control populations, the Chi-square test was used. A probability of  $p < 0.05$  considered statistically significant.

### Results and Discussion

Table 1 show the total mortality and mortality cause by cancers and psychiatry disorders in MIS, Izeh, Shoshtar and Khozestan province during two years.

Statistical analysis of data demonstrated that there were significant differences between MIS and Khozestan province for cancers ( $\chi^2 = 20.58$ ,  $df = 1$ ,  $p < 0.00001$ ) and psychiatric disorders ( $\chi^2 = 43.79$ ,  $df = 1$ ,  $p < 0.00001$ ) related mortalities. There were significant differences for mortalities between MIS and Izeh due to cancers ( $\chi^2 = 7.24$ ,  $df = 1$ ,  $p = 0.0071$ ) and psychiatric disorders ( $\chi^2 = 17.88$ ,  $df = 1$ ,  $p = 0.00002$ ). Also there were significant differences for mortalities between MIS and Shoshtar due to cancers ( $\chi^2 = 9.23$ ,  $df = 1$ ,  $p = 0.0023$ ) and psychiatric disorders ( $\chi^2 = 9.80$ ,  $df = 1$ ,  $p = 0.0017$ ).

It should be mentioned that there was no difference between Shoshtar and Khozestan province for mortalities due to cancers ( $\chi^2 = 0.0$ ,  $df = 1$ ,  $p = 0.980$ ) and psychiatric disorders ( $\chi^2 = 0.69$ ,  $df = 1$ ,  $p = 0.408$ ). Also there was no difference between Izeh and Khozestan province for mortalities due to cancers ( $\chi^2 = 0.05$ ,  $df = 1$ ,  $p = 0.818$ ). However there is a borderline significant difference between Izeh and Khozestan province for mortality due to psychiatric disorders ( $\chi^2 = 4.58$ ,  $df = 1$ ,  $p = 0.032$ ). In Izeh mortality due to psychiatric disorders is less than Khozestan province. Considering that citizen of MIS and Izeh are belonging to same ethnicity group (named Bakhteriay), it should be stressed that ethnicity can not explained the high level of mortality due to psychiatric disorders in MIS.

No studies into the mutagenic or carcinogenic potential of H<sub>2</sub>S were reported. However, a study in which rats were orally administrated with sodium sulfide for 78 weeks did not present any evidence of carcinogenicity (Costigan, 2003). The epidemiological studies have linked SO<sub>2</sub> exposure and lung

**Table 1: Mortality due to cancers, psychiatry disorders and other causes in MIS, Izeh, Shoshtar and Khozestan province**

| Populations        | Mortality due to |                      |              |
|--------------------|------------------|----------------------|--------------|
|                    | Cancers          | Psychiatry disorders | Other causes |
| Masjid-I-Sulaiman  | 108              | 33                   | 1171         |
| Izeh               | 41               | 1                    | 756          |
| Shoshtar           | 77               | 14                   | 1353         |
| Khozestan province | 1413             | 208                  | 24950        |

cancer (Meng and Zhang, 1992). Several studies have shown that the frequencies of micronuclei, chromosomal aberrations and sister chromatid exchanges in peripheral blood lymphocytes of factory workers chronically exposed to SO<sub>2</sub> were higher than the controls (Meng and Zhang, 1990; Yadav and Kaushik, 1996). It was reported that the hydrated forms of SO<sub>2</sub> (bisulfite and sulfite) induced micronuclei, chromosomal aberrations and sister chromatid exchanges formation in cultured human lymphocytes *in vitro* (Meng and Zhang, 1992; Rencuzogullari *et al.*, 2001). Based on these reports it might be concluded that exposed chronically to natural sour gas which contain several compounds such as H<sub>2</sub>S, SO<sub>2</sub> and SO<sub>3</sub> increases the mortality due to cancers.

The endogenous levels of H<sub>2</sub>S have been measured in the human brain, suggesting that H<sub>2</sub>S may have a physiological function (Savage and Gould, 1990; Abe and Kimura, 1996). It is showed that increase or decrease of brain hydrogen sulfide is associated with Down's syndrome and Alzheimer's disease, respectively (Eto *et al.*, 2002; Kamoun *et al.*, 2003). Therefore, alteration(s) in H<sub>2</sub>S level is coupled with brain dysfunction. Our recent reports indicated that in MIS the incidence of suicide attempts, completed suicide and suicide by self-burning is remarkably high (Saadat *et al.*, 2004b) and MIS citizens are more at risk to be depressed and hopeless compared to control group (Saadat *et al.*, 2006). Present results indicated that mortality due to psychiatric disorders in MIS increased significantly. Taken together, it is suggested that high level of sulfur compounds in MIS has some role in the high mortality due to psychiatric disorders in MIS.

In this situation, health-care providers need to be aware of the possible role(s) of natural sour gas leakage on causes of mortality of MIS citizens. Other study describing the age and sex specific mortality rates due to cancers and psychiatry disorders are necessary.

### **Acknowledgements**

This study was supported by Shiraz University.

### **References**

- Abe, K. and H. Kimura, 1996. The possible role of hydrogen sulfide as an endogenous neuromodulator. *J. Neuro. Sci.*, 16: 1066-1071.
- Costigan, M.C., 2003. Hydrogen sulfide: UK occupational exposure limits. *Occup. Environ. Med.*, 60: 308-312.
- Divine, T.D., M.M. Hartman and K.W. Kim, 1996. Mortality among workers at a butadiene production workers. *Toxicology*, 113: 169-181.
- Eto, K., T. Asada and K. Arima *et al.*, 2002. Brain hydrogen sulfide is severely decreased in Alzheimer's disease. *Biochem. Biophys. Res. Commun.*, 293: 1485-1488.
- Kamoun, P., M. Belardinelli and A. Chabil *et al.*, 2003. Endogenous hydrogen sulfide overproduction in Down's syndrome. *Am. J. Med. Genet.*, 116A: 310-311.
- Lee, G.M., 1953. *Persia in the Science of Petroleum*. Oxford University Press, London and New York, Part I, pp: 50.
- Levirsen, A.L., 1967. *Geology of Petroleum*. WH Freeman and Company. San Francisco, pp: 15-19.
- Mavaluso, M., R. Larson and E. Delzell *et al.*, 1996. Leukemia and cumulative exposure to butadiene, styrene and benzene among workers in the synthetic rubber industry. *Toxicology*, 113: 190-202.
- Meng, Z.Q. and L.Z. Zhang, 1990. Chromosomal aberrations and sister chromatid exchanges in lymphocytes of workers exposed to sulphur dioxide. *Mutat. Res.*, 241: 15-20.
- Meng, Z.Q. and L.Z. Zhang, 1992. Cytogenetic damage induced in human lymphocytes by sodium bisulfite. *Mutat. Res.*, 298: 63-69.

- Rencuzogullari, E., H.B. Ila and A. Kayraldiz *et al.*, 2001. Chromosome aberrations and sister chromatid exchanges in cultures human lymphocytes treated with sodium meta-bisulfite, a food preservative. *Mutat. Res.*, 490: 107-112.
- Saadat, M., M. Ansari-Lari and A. Bahaoddini, 2002. Sex ratio at birth in Masjid-I-Sulaiman (Khozestan province, Iran). *Occup. Environ. Med.*, 59: 853.
- Saadat, M., A. Bahaoddini and M. Ansari-Lari, 2003. Possible effect of maternal hormones and GST genotypes on sex of offspring. *Occup. Environ. Med.*, 60: 704.
- Saadat, M. and A. Bahaoddini, 2004. Hematological changes due to chronic exposure to natural gas leakage in polluted areas of Masjid-I-Sulaiman (Khozestan province, Iran). *Ecotoxicol. Environ. Saf.*, 58: 273-276.
- Saadat, M., A. Bahaoddini and S. Nazemi, 2004a. Alteration in blood pressure due to chronic exposure to natural sour gas leakage containing sulfur compounds. *Biochem. Biophys. Res. Commun.*, 313: 568-569.
- Saadat, M., A. Bahaoddini and H. Mohabatkar *et al.*, 2004b. High incidence of suicide by self-burning in Masjid-I-Sulaiman (south-west of Iran), a polluted area with natural sour gas. *Burns*, 30: 829-832.
- Saadat, M., Z. Zende-Boodi and M.A. Goodarzi, 2006. Environmental exposure to natural sour gas containing sulfur compounds results in elevated depression and hopelessness scores. *Ecotoxicol. Environ. Saf.* (In Press).
- Savage, J.C. and D.H. Gould, 1990. Determination of sulfides in brain tissue and rumen fluid by ion-interaction reversed-phase high-performance liquid chromatography. *J. Chromatogr.*, 526: 540-545.
- Tsai, S.P., J.K. Wendt and J.D. Ransdell, 2001. A mortality, morbidity and hematology study of petrochemical employees potentially exposed to 1,3-butadiene monomer. *Chem. Biol. Interact.*, 135-136: 555-567.
- Yadav, J.S. and V.K. Kaushik, 1996. Effect of sulfur dioxide exposure on human chromosome. *Mutat. Res.*, 359: 25-29.